# Marine Engineering and Shipping Age

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H. H. Brown, Editor
L. S. Blodgett, Managing Editor
Warner Lumbard, Associate Editor

James Swan, Contributing Editor

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## Ship Costs

ONE very obvious result of the Jones-White Bill will be the establishment by the government of some agency, presumably inside the Shipping Board organization, to determine a fair price for proposed vessels towards the construction of which the government is asked to loan money.

The question of the cost of building a new vessel or, more explicitly, the fair price which the owner should be expected to pay and the government to loan money upon is bound to be more or less controversial. An arbitrary fixing of the price by the government would only lead to trouble and might result in defeating the underlying purpose of the bill. On the other hand it is evident that both the prospective owner and the government should have some means of protection against unreasonable charges on the part of the shipbuilders. From past experience the writer is inclined to the belief that it is the shipbuilders rather than the owners or the government who will need protection.

One cannot but feel that there is a serious lack of understanding of the shipbuilding situation and of the methods and costs of shipbuilding on the part of almost every governmental department or agency, including the Congress itself. While the fact that a ship is built and not manufactured and that she cannot be produced by the same methods used for fabricating automobiles and stock gasoline engines is more generally understood now than immediately after the late war, it is still far, apparently, from being fully appreciated by many of those who will in all probability have an important part in fixing the prices of and the loaning of money on new vessels under the working of the Jones-White Bill.

That a misunderstanding exists is in large part due to the shipbuilders. As a result of the "slump" in shipbuilding seven or eight years ago, the contracts that were placed were at such prices that labor and material, let alone overhead, could hardly be covered. Although such practice might be justified in isolated cases, it was persisted in by the managers of one or two of the large shipyards with results which were not only disastrous to them but, what is more important at present, also established in the minds of shipowners and operators, both private and government as well, an entirely erroneous standard of ship prices. The practice of selling ships which cost to build say $105 a deadweight ton, for $90 or less is not only an immediately losing proposition but cannot fail to have a most depressing effect upon future business. Apparently the latter result is now making itself felt.

Over a year ago the Council of American Shipbuilders conducted a rather searching investigation of the cost of building ships. The fact was established that, as of the year 1926, in order to realize a profit on the construction of a cargo steamer of about 10,000 tons deadweight and 10½ knots speed in an American shipyard, the vessel must sell for over $100 per deadweight ton. Acting under the provisions of the Jones-White Bill, it is understood that certain shipowners are now proposing the construction of steamers of 14 knots speed and approximately 9000 tons deadweight. Furthermore it is rumored that they have been expecting to place these ships at a price in the neighborhood of $125 a deadweight ton, a limited amount of passenger accommodation being included.

Taking the 10,000-ton ship above mentioned as a basis, it may be of interest to note the effect on the price per ton of this vessel of increasing her speed to 14 knots and of adding comfortable quarters for 50 passengers, assuming that the general dimensions of the hull remain unchanged. In the first place the block coefficient would have to be decreased from 0.78 to possibly 0.73, thus reducing the displacement and consequently the deadweight capacity by approximately 900 tons, even after allowing for the fact that the finer hull would weigh somewhat less than the full one. Next the power would



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have to be greatly increased—probably doubled—in order to maintain the 14 knots speed at sea in ordinary weather. This would add some 350 tons to the weight of the vessel with a further decrease in deadweight. It would also increase the cost by probably $130,000. Finally the joiner work, plumbing, additional lifeboat equipment and miscellaneous fittings incident to the carrying of passengers, would account for another increase in the weight of the ship as well as a decrease in deadweight capacity of about 150 tons. The accompanying increase in cost for these items would amount to $50,000. Altogether the decrease in deadweight would amount to perhaps 1400 tons and the additional cost to $180,000, the net result being that the cost per ton of the faster ship with accommodations for 50 passengers would be in the neighborhood of $145 instead of about $105, the price of the original slow cargo vessel.

The figures given are of course approximations, but they are on the conservative side and at least show the utter futility of comparing the costs of ships of different types on a deadweight-ton basis. The vast majority of the emergency-built vessels were of practically the same type and for them a deadweight-ton basis of comparison was fairly accurate. It is perhaps not surprising, among those whose entry into the shipping business, coincided with the building of the Shipping Board vessels, that the cargo-carrying capacity is the only recognized basis of comparing costs. These individuals have had little or no experience with any other class of ships. Unfortunately this point of view seems to influence the judgment of many who should know better. Not only for their own protection but to make possible an economic and material shipping development under the Merchant Shipping Bill of 1928, the shipbuilders must exert every effort to clear up the situation.

# Corrosion

OCCASIONALLY one runs across an item in the semi-technical press relating to the ravages wrought by corrosion upon metals. Impressive figures of the total annual wastage are given which, if taken at their face value, might almost lead to the belief that a considerable portion of the financial resources of the entire world must be devoted to resisting the workings of the destructive forces of nature and to replacing what they destroy to even maintain the balance. Of course such statistics are not susceptible of proof but are rather in the nature of "scare headings" for the entertainment of the casual reader. Similar wastage and deterioration are going on in every structure produced by the hand of man. The maintenance of these structures is a perfectly well recognized factor in human existence and is not "waste" in the ordinary sense.

Nevertheless, while it may be impossible to put into actual and accurate figures the extent of this gradual and persistent wasting away, the fact that it does exist and is constantly in evidence everywhere in greater or lesser degree, furnishes the maintenance engineer in every field with a very large part of his total problem. In the marine field, probably to a greater extent than in any other, corrosion and its effects occupy the attention of those whose business it is to attend to upkeep and maintenance. It is a problem which is always with them and which is responsible for a large part of their yearly expenditures.

Leaving aside for the moment questions of local and special wastage such as failures of condenser tubes, it is interesting to consider the effect of corrosion in general, upon the average life of steel vessels. It is a customary practice in figuring book depreciation of vessels to assume their useful life as 20 years; that is, a "straight-line" depreciation of 5 percent per year is assumed in fixing current value. This of course is based upon usual upkeep and replacement as required to maintain a ship in useful and workable condition during this 20 year period. To keep a ship running for even 20 years, certain local replacements are expected and accepted as ordinary upkeep, their extent depending largely upon the service in which the vessel is engaged. Thus a sea-going vessel in long-voyage trade will require new boilers perhaps every 10 or 12 years. For short trips, where unlimited fresh water is available and there is ample time in port for minor renewals and repairs, boilers may be kept serviceable for twice this time.

It is to the steel hull, itself, that we must look to form an opinion as to the useful life of the ship as a whole. Barring accidents, how long will the hull of a steel vessel last, assuming of course that she receives reasonable care, is drydocked regularly at least once a year and paint or other protective coatings maintained in reasonably good condition? If one can find an answer to this question, he is by way of determining the effect of corrosion upon the life of a steel vessel. Physicians tell us, that a man's serviceable age is indexed by the condition of his arteries. The serviceable age of a ship may similarly be fixed by the condition of her shell plating and the framing adjacent to it. Here the service in which a vessel is engaged may of course make itself felt, but special conditions will be taken care of by special provisions in upkeep and may be disregarded in the present connection. Thus a vessel running in shallow water with sandy bottom will need more or less frequent renewal of bottom plating, but this is accepted as a necessary part of regular upkeep.

Plain wear and wastage of shell plating arises from both chemical and electrolytic action. The latter usually is mainly in evidence in the eating away of rivet points. Of recent years, due to the occasional presence of copper in shell plates, this action is sometimes violently destructive, but ordinarily the wasting of rivet points does not quite keep pace with shell corrosion. An examination of the bilge plating of a steel ship, say 30 years of age, is likely to bring to light the fact that

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the rivet points, originally flush, protrude visibly above the surrounding plating, evidently indicating an appreciable reduction in thickness of the plate as a whole. When this condition is accompanied by local pitting, which is very likely to be the case, one is confronted with a real problem. Shell plate replacement is expensive. Nearly always when the conditions mentioned obtain, the renewal of frames and possibly of floor plates as well is required. Repairs once they are started are likely to prove much more extensive than is indicated by surface conditions alone. Then, indeed, it is time to take "account of stock," for the renewal cost may well amount to a very appreciable portion of the depreciated value of the ship. Even if all wasted portions are made good, the ship remains an old ship and her book value cannot properly be increased.

The age at which the above described conditions occur will vary appreciably with the care which has been taken of the ship. No matter how alert and painstaking the owners have been, they will sometime be confronted with the necessity of making the decision between repairing and scrapping—provided of course they are not subject to the competition of newer and more efficient vessels. Even when the former situation serves to prolong useful life, it is obvious enough that the time must sometime come when repairs will not "pay." Just when the decision to scrap can no longer be delayed will naturally vary. At least it is certain that with ordinary good care, the hull of a steel vessel will remain serviceable for a much longer period than 20 years.

Experience with well built ships constructed of the best obtainable materials indicates that a service life of from 30 to 35 years may reasonably be expected. With the aid of somewhat more than ordinary repairing, 40 years may easily be realized.

In ordinary service, particularly with any material competition, obsolesence will determine the extent of a ship's useful life, rather than corrosion or other similar actions. The fact that a ship may with the best of reasons be expected to last in the physical sense much longer than 20 years, should be recognized and taken account of in valuation and depreciation, calculations and accounting.

The present discussion has touched upon the relation of corrosion to service life—later it is proposed to consider in some detail its action during that life and the methods by which it may be controlled or retarded.

# The Steward's Department

L. SCHUMACHER, commissary controller of the United States Lines, points out elsewhere in this issue numerous faults that exist in the location and arrangement of the galleys, pantries and dining rooms on certain types of passenger vessels in service today and makes some practical suggestions as to how these faults can be corrected. In doing this he analyzes the operation of the steward's department and shows why certain arrangements are impractical and wasteful and others are economical and efficient. His discussion of this problem is based upon years of practical experience in this class of work on passenger vessels of all types, including the largest afloat, and should be of inestimable value to both shipowners and shipbuilders.

In calling attention to these shortcomings Mr. Schumacher goes to the root of the matter and calls the designer to account for his failure to make a thorough study of the practical operation of the steward's department or to secure the cooperation of competent stewards and chefs before laying out this important part of the vessel's equipment. He states that among practical stewards there is a strong belief that in the design of many transoceanic liners on which passenger transportation is the main factor first consideration was given to the arrangement of cargo holds and hatches and the installation of machinery, while the remaining space was considered good enough for the steward's department and no attempt was made to overcome inherent obstacles imposed by other factors in design. While it is true that in many cases the arrangement of machinery is susceptible to little change, there is usually an opportunity to make slight modifications here and there that will make possible desired improvements in the arrangement of the steward's department, provided the necessity and importance of doing so are understood. Here is where consultation with the stewards and chefs in the early stages of design is not only desirable but imperative, if an economical and efficient arrangement of the steward's department is to be obtained. Changes are more easily and cheaply made on paper than they are after the structural work has been completed and the equipment installed.

On large passenger vessels the steward's department comprises not only the largest but also the most expensive part of the crew. Their work involves the handling, storing and preservation of immense quantities of foodstuffs and the preparation, cooking and serving, for hundreds of passengers, of meals that are equal or superior, in quality and variety, to those obtainable in the finest hotels ashore. In fact, one of the outstanding features that impresses the ocean traveler today is the abundance and variety of excellent food offered on the big liners. The high standards of both food and service must be maintained at all costs and consequently the problem of the steward's department can in no way be considered secondary. The amount of money involved, both in first cost and in operating charges, makes economy and efficiency in the steward's department of first importance.

That many important considerations in the layout of galleys, pantries and dining rooms have been overlooked or neglected in the past by American shipbuilders may

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be accounted for by the fact that they have had little opportunity to deal with the problem of the big passenger liner. Most of the passenger vessels built in American yards in recent years have been designed for relatively short runs in coastwise service. The experience gained in this class of work is, of course, a valuable guide but on such vessels the steward's department is much simpler than it is in the case of a large liner designed for long voyages overseas. Fortunately, the Merchant Marine Act of 1928 will bring to American yards considerable work of this class in the near future, which makes this an opportune time for giving special consideration to the problem of the steward's department on this type of vessel.

As the size of the vessel increases, the problem of feeding the crew becomes of greater importance. Mr. Schumacher's solution of this problem consists of the centralization of all crew messes. The serving of food in separate dining rooms for different classes of the crew at a considerable distance from the main galley where it is prepared obviously requires extra equipment and additional service while at the same time much of the food's appetizing effect is lost by the time it is served and the waste of food is enormous. Centralization would reduce the amount of equipment and the number of men required and would result in uniform cooking with simplification in the issues from the storeroom and a more effective food control. Centralization of the crew messes, should be adopted when the vessel is designed so that this feature can be incorporated in the general arrangement of the steward's department.

The faults that Mr. Schumacher points out are too numerous to mention here but there are certain features that are worth careful consideration as a basis for good practice. In the first place the galley, pantry and dining room should be located on the same level. This would seem to be an obvious, common-sense requirement for efficient and economical operation and yet only recently in the preliminary design for some large transatlantic liners proposed in this country the main galley was located on one deck and the pantry and dining room on another. Another obstacle that reduces efficiency and economy is a hatch that extends partly through the dining room and partly through the pantry. This creates congestion at a point where freedom of movement in service is essential. This difficulty could in most cases be easily avoided by careful planning in the original arrangement of the spaces. Noise from the pantry is particularly disagreeable to the passenger in the dining room and every effort should be made to eliminate it. While this may seem a trivial matter, experience shows that it is something that will well repay careful attention. Duplicate galley service has been tried out recently for the first time but a diversity of opinion apparently exists as to the usefulness of this innovation. At all events the objections raised to this method of handling the service deserve careful consideration before another attempt is made to apply it.

As many of the faults found in existing ships have been the result of lack of cooperation between the builders and the men who are responsible for the operation of the vessels, we will gladly welcome further criticism and constructive suggestions from both those who are responsible for the layout of galley equipment on passenger vessels and those who are responsible for its operation.

# Boiler Improvements

IN a paper on the "Efficient Combustion of Coal," recently presented before the Society of Consulting Marine Engineers and Ship Surveyors in England, Mr. A. Macfarlane, managing director of James Howden & Company, Ltd., pointed out that future improvement in marine boilers would appear to be in the direction of higher steam pressures and superheats and the intelligent application of feedwater heating, together with greater heat recovery from the flue gases. The losses of heat from a boiler comprise the loss of sensible heat in the flue gases, the radiation loss and the "other lossess" usually associated with the radiation loss, including the ash loss and those due to the reactions in combustion of the fuel. The recovery of heat from the flue gases, combined with forced draft, remains the most outstanding improvement yet made on marine boiler efficiency. In general, for each reduction of 100 degrees Fahrenheit in the flue gas temperature a saving of 3.88 percent is effected. As this saving of heat is an absolute quantity it is added directly to the previous efficiency of the boiler. When the reduction of the flue gas temperature is performed by means of an air preheater, there are two more causes of further increase in efficiency; first, less excess air is required per pound of fuel, and, second, owing to the decreased amount of excess air the furnace temperature is raised with increased $CO_2$, causing an increase in the amount of heat transmitted to the furnace walls by radiation.

Hand firing of coal, which is practically universal at sea, is a decided handicap to efficient combustion, and some form of mechanical firing and handling of coal, either in conjunction with mechanical stokers or pulverized fuel, must come sooner or later. The Scotch boiler, however, is not readily adaptable to modifications of methods of firing or to great increases in pressure. To meet these conditions an experimental boiler, carrying 315 pounds per square inch pressure, has been in operation at the Howden works for over two years in which the valuable features of both Scotch and watertube boilers have been combined. Combustion is effected in a number of cylindrical furnaces which extend clear through the cylindrical part of the boiler and are surrounded by large water space while the gases of combustion pass through banks of watertubes outside of the boiler on their way to the air heater and stack. High pressures, light weight, rapid circulation and greater heating surfaces are thus made possible and tests with oil fuel have shown boiler efficiencies of from 87.33 to 88.5 percent.

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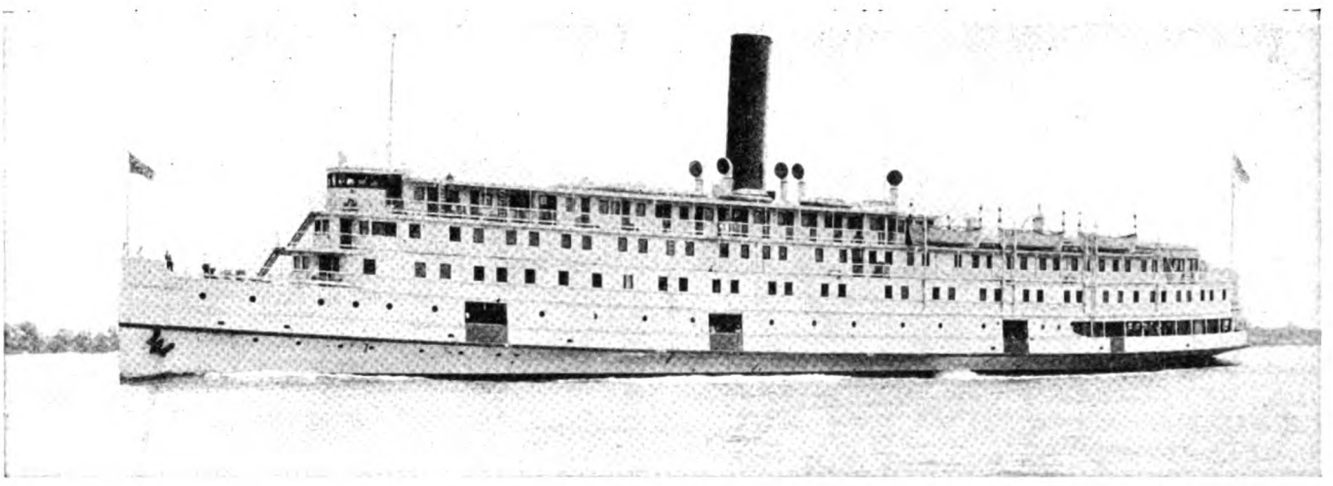


S. S. President Warfield on her trial trip

# Passenger Steamer President Warfield

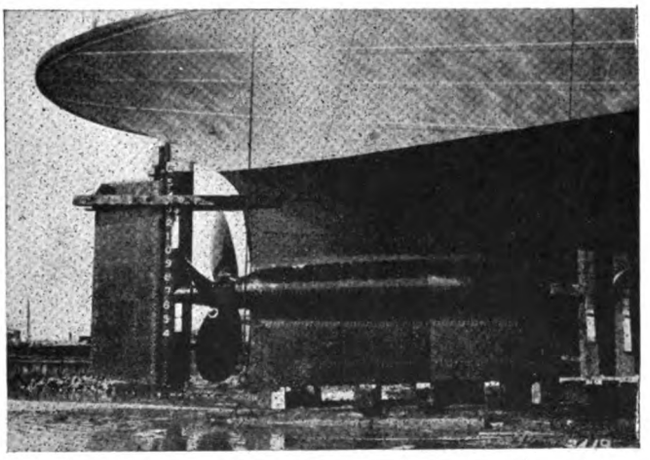
## Built by the Pusey & Jones Corporation for the Baltimore Steam Packet Company

THE latest addition to the fleet of the Baltimore Steam Packet Company, Baltimore, Md., familiarly known as the Old Bay Line, is the *President Warfield,* a fast bay steamer completed by the Pusey & Jones Corporation, Wilmington, Del., on July 12, for night service between Baltimore, Old Point Comfort and Norfolk. This vessel is practically a duplicate of the steamers *State of Maryland* and *State of Virginia,* which were built by Pusey & Jones for the Old Bay Line in 1922.

Except for minor changes in the accommodations and fittings, the principal difference between the *President Warfield* and her sister ships is the change in the type and size of the propeller, which has been made to fit it for service with the Oertz streamline rudder, which is installed. Bilge keels have also been omitted on the present steamer. This combination, as will be noted from the test data given later, has resulted in an increase in efficiency of this vessel as compared with the preceding steamers.

The *President Warfield* has a steel hull flared out at the guards, with steel superstructure sides up to the saloon deck. Above this the superstructure is of wood construction reinforced with steel. The hull is built on the transverse system to the highest class of the American Bureau of Shipping Rules for Bay Service. The principal dimensions of this steamer are as follows:

| | |
|---|---|
| Length overall | 330 feet 0 inches |
| Length between perpendiculars | 320 feet 0 inches |
| Beam, molded at main deck | 56 feet 6 inches |
| Beam over guards | 58 feet 0 inches |
| Depth, molded | 18 feet 6 inches |
| Mean load draft | 14 feet 6 inches |
| Indicated horsepower | 2660 |
| Speed | 18½ miles per hr. |
| Total hold cargo capacity | 15,740 cubic feet |
| Lower deck non-refrigerated cargo | 4570 cubic feet |
| Lower deck refrigerated cargo | 7116 cubic feet |
| Total main deck cargo capacity | 55,100 cubic feet |
| Total cargo space | 82,526 cubic feet |
| Coal bunker capacity | 118 tons |
| Boiler feedwater | 55 tons |
| Culinary water | 30 tons |
| Passenger Capacity: | |
| First-class passengers | 510 |
| Second-class passengers | 21 |
| Total Passengers | 531 |
| Crew | 70 |



Oertz rudder installation on S. S. President Warfield

### Arrangement of Lower Deck Spaces

On the lower deck of the *President Warfield,* aft of the engine room, are located the galley and pantry, which are larger than on the sister ships. Forward of the galley are located the waiters' quarters, officers' and crew's mess rooms and second-class passenger accommodations. A coal bunker of 118 tons capacity with a boiler feedwater tank under is located forward of the boiler room. Space is provided on the starboard side of the vessel on this deck for refrigerated cargo and on the port side for non-refrigerated cargo. Refrigerating machinery, supplied by the Brunswick-Kroeschell Company, New Brunswick, N. J., and by the Remington Machine Company, Wilmington, Del., is enclosed in a steel casing. In the lower hold forward of the coal bunker, additional second-class passenger accommodations, as well as quarters for oilers, seamen and firemen are provided. The chain locker is also located at this point.

On the main deck aft is the dining room, which is of



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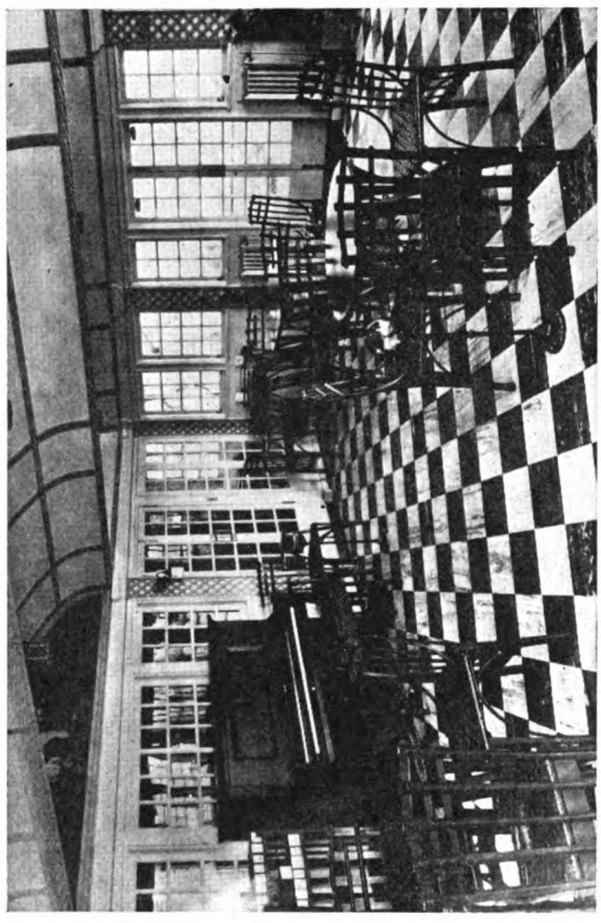
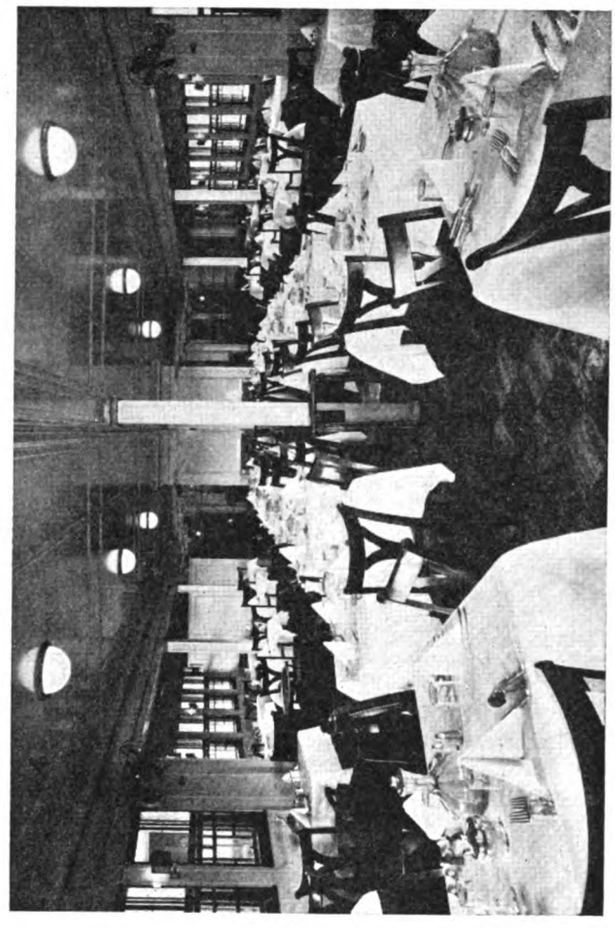
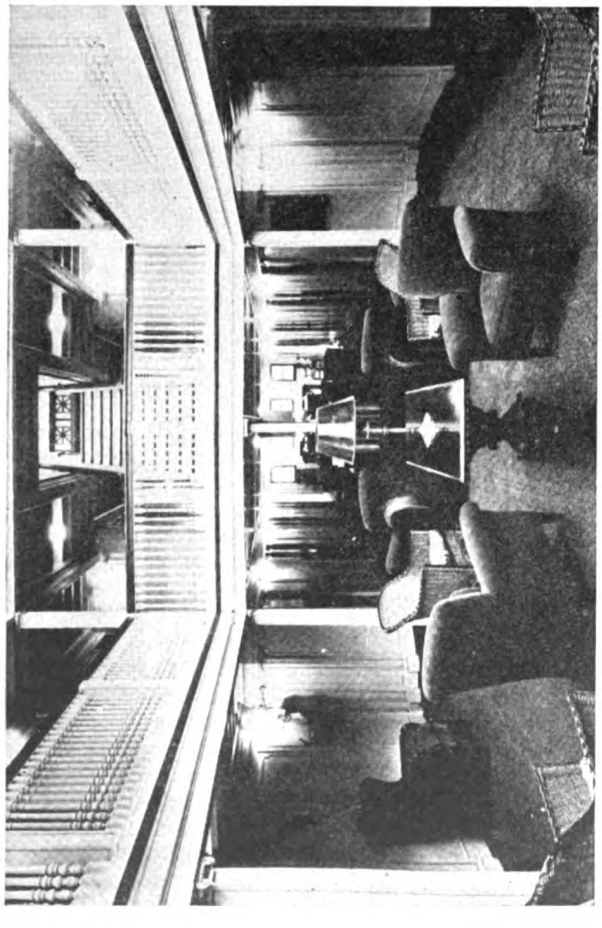


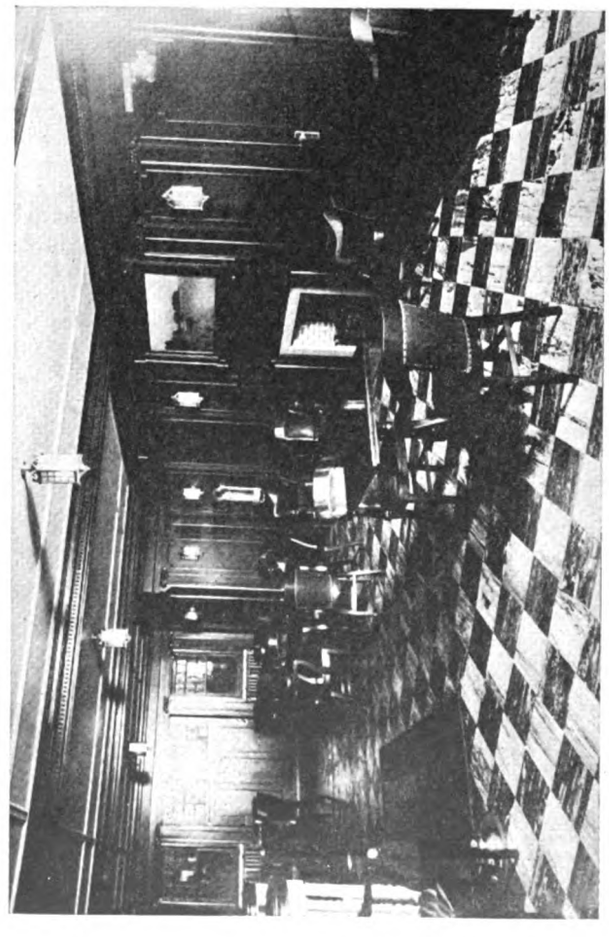
Palm room



Dining room



Saloon deck, forward



Social hall

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steel construction. The dining room is served from the galley below by a wide stairway. The steering engine is located aft of the dining saloon in a separate steel house, with wire rope leads and shafting to the pilot house. Forward of the dining room is the social hall with a barber shop adjoining. Access to the saloon deck is by means of a wide stairway adjacent to the social hall. Here also on the port and starboard sides are located the chief engineer's and assistant engineers' quarters.

Freight space is also provided for on the main deck, extending from the social hall forward to the mail and baggage rooms in the fore part of the ship. Two elevators for loading and unloading freight serve the lower holds from the main deck freight space. Forward of the freight space are special freight and express rooms, the mail room, mail clerks' staterooms, crew's showers and toilets and a stairway leading to the saloon deck. A steam windlass for handling the anchors is located forward and two steam capstans are placed aft on this deck for warping the ship.

The saloon deck is entirely devoted to passenger accommodations. Hot and cold running water is provided in each stateroom and bed room. The staterooms have a metal upper and lower berth and can be reserved as single rooms or as communicating rooms. A number of these staterooms are fitted with showers while others have pullman toilets. A number of bed rooms are included in the accommodations, some of which are fitted with a double bed and others with two single beds. Several of these bed rooms have adjoining baths and toilets, while others are fitted with an enclosed shower and toilet.

The men's lavatories are located amidships on the port side, while the women's lavatories and dressing rooms are amidships on the starboard side. The purser's office is located on the starboard side forward. The main stairway, which is immediately forward of the boiler room casing, leads to the gallery deck.

The palm room, which is especially adaptable for dancing, is located aft on the gallery deck. The staterooms on this deck are arranged in single rooms and rooms that can be combined in suites, all of which are equipped with upper and lower metal berths and hot and cold running water. Some have adjoining bath rooms, while others have private showers.

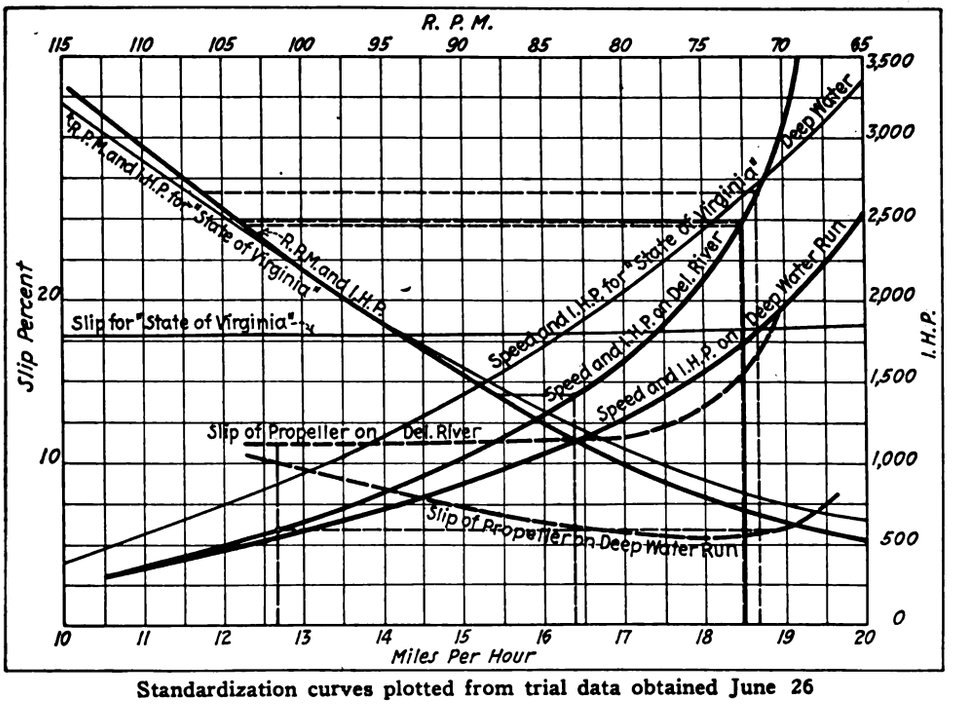
The rooms on the hurricane deck all of which have an outside exposure are built around the engine and boiler room casing and light well. These rooms are arranged as staterooms with the same equipment as in the case of those on the saloon deck. Forward of the passenger quarters are the captain's and officers' staterooms and captain's office, communicating with the pilot house, which is equipped with the latest safety appliances and navigating instruments. All accommodation spaces on this ship are heated by steam radiators having individual controls. Electric fans and reading lamps are also installed in each room and stateroom.

The floors in the dining room, social hall, palm room and all saloons and alcoves on the saloon, gallery and hurricane decks are covered with rubber tile. The floors of all staterooms and bed rooms are covered with linoleum and with rugs.

The Colonial period of design has been followed throughout the interior decorations. The general finish is white throughout with mahogany doors and trim and white metal hardware. All inside bulkheads are paneled with Haskelite. The ceiling in the dining room is paneled with Vehisote, while the social hall is finished in mahogany.

### Details of Machinery

The main propelling machinery consists of one inverted, four-cylinder, triple-expansion steam engine with surface condensers. This engine, which was built by the Pusey & Jones Corporation, has cylinder diameters of 24½ inches, 40 inches, 47 inches and 47 inches, with a stroke of 42 inches. Steam is supplied by four single-ended Scotch marine boilers, built to the requirements of the American Bureau of Shipping and the United States Steamboat Inspection Service for a working pressure of 185 pounds a square inch. These boilers have a mean diameter of 13 feet 3 inches and a length of 11 feet 6 inches. Each boiler is fitted with three Morison corrugated furnaces having inside diameters of 3 feet 9 inches. The total heating surface of the boilers is 8372 square feet and the total grate area is 284 square feet. The boilers are arranged to burn coal on a natural draft.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Speed and I.H.P. on Deep Water Run
Speed and I.H.P. on Del. River
Deep Water
10 11 12 13 14 15 16 17 18 19 20
Miles Per Hour

**Standardization curves plotted from trial data obtained June 26**

The propeller, which is of considerable interest on the *President Warfield* since the high efficiency of the machinery in this vessel, as compared with that of her sister ships, is largely due to this propeller working in conjunction with the Oertz rudder, is a solid manganese bronze casting, having four blades. The diameter of the propeller is 12 feet 6 inches, pitch 18 feet 6 inches, the developed area 69.8 square feet and the projected area 52.6 square feet.

Two 40-kilowatt generator sets are used to supply direct current at 110-125 volts for lighting and power purposes. The generators are each driven by an Engberg 10-inch by 10-inch vertical steam en-

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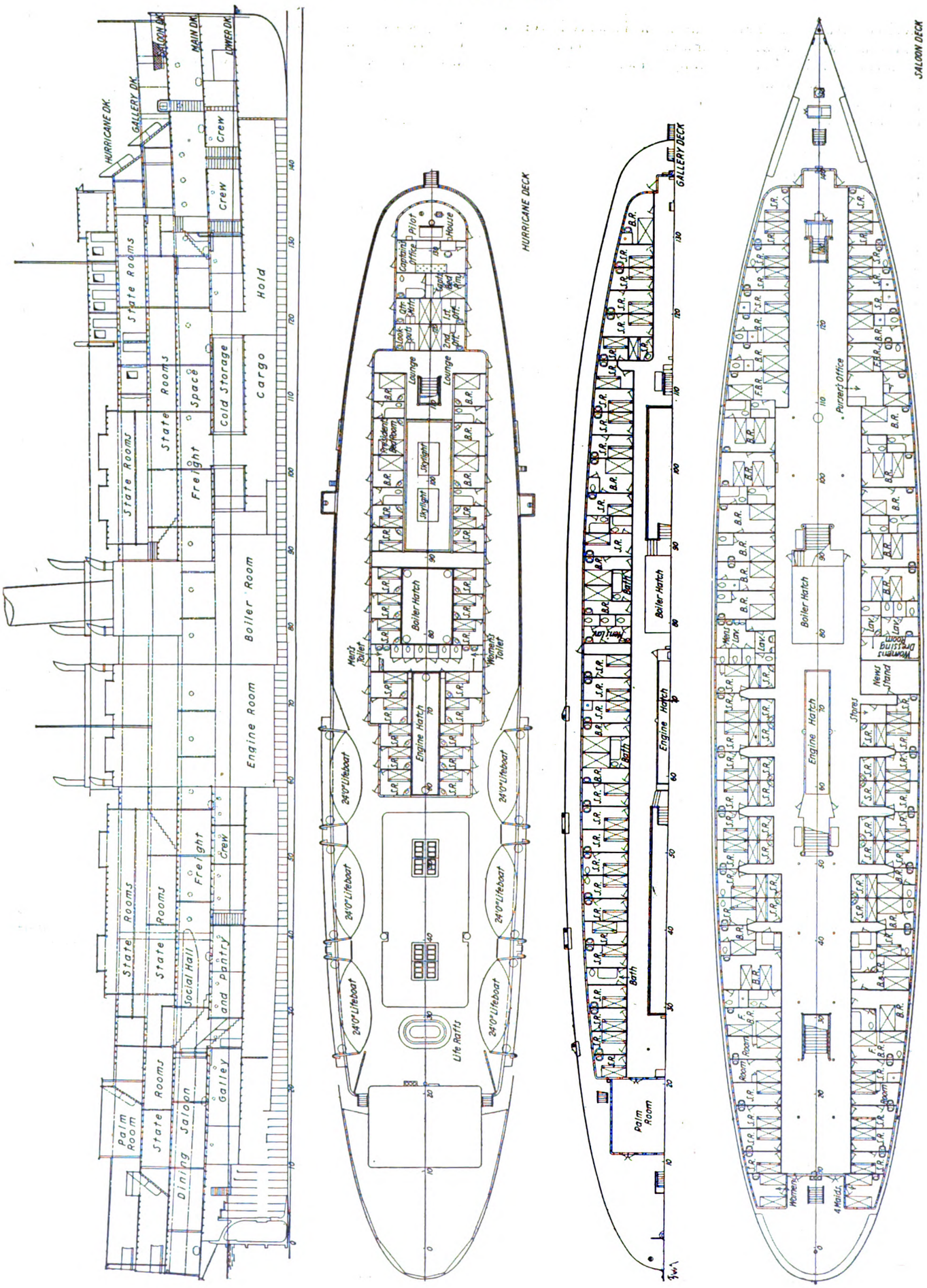


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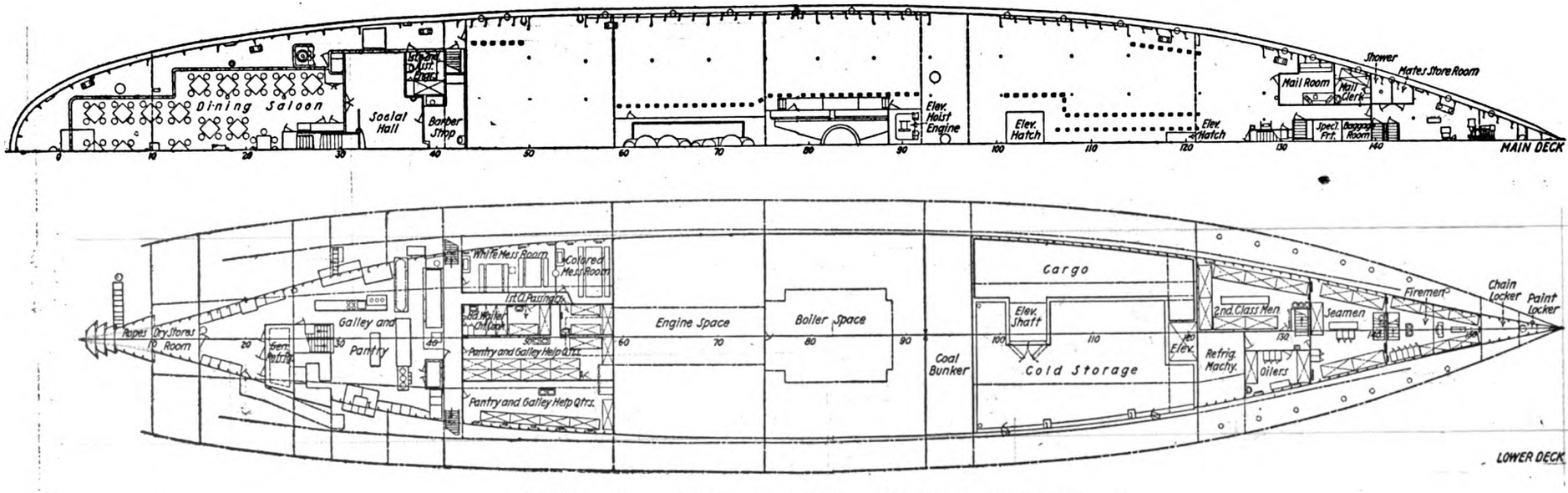
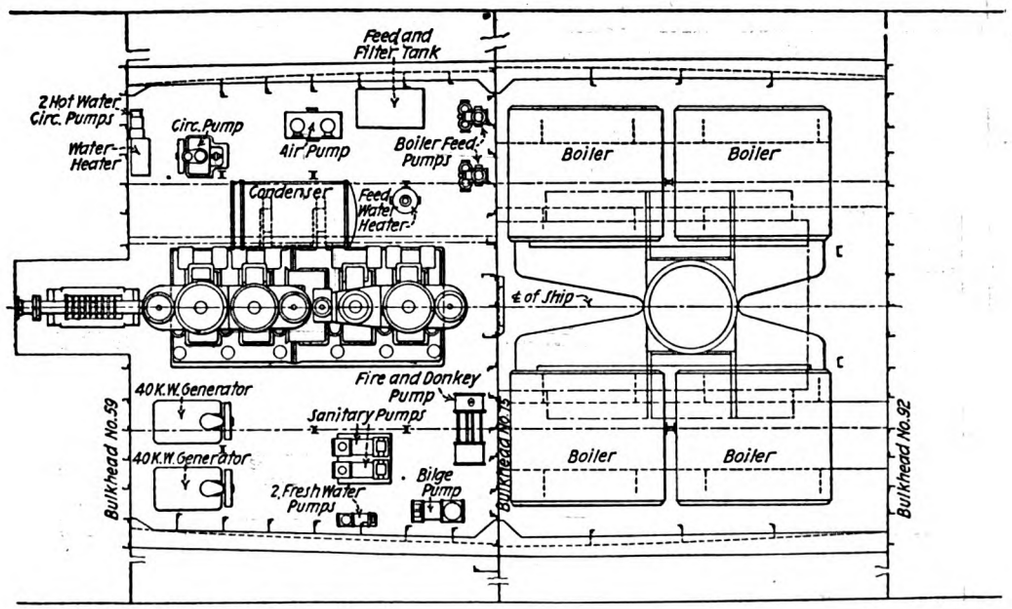
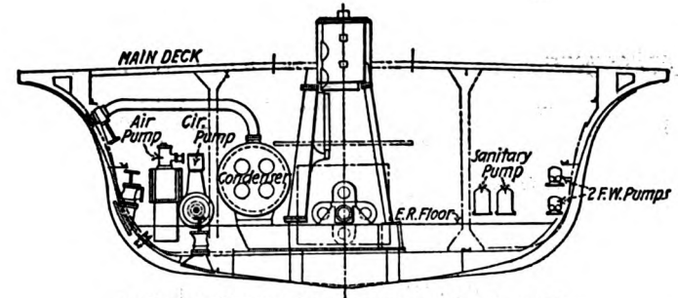
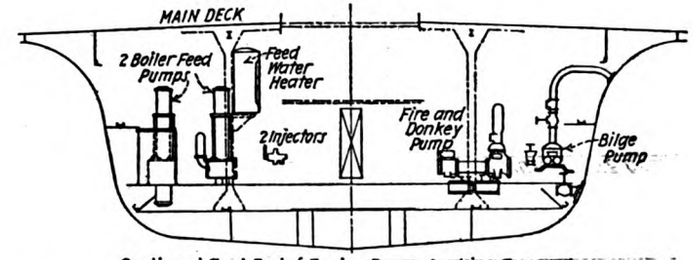



Inboard profile and deck plans of steamship President Warfield




Section at Aft End of Engine Room - Looking Forward




Section at Ford. End of Engine Room - Looking Forward

Arrangement of machinery and sections through engine room of steamship President Warfield

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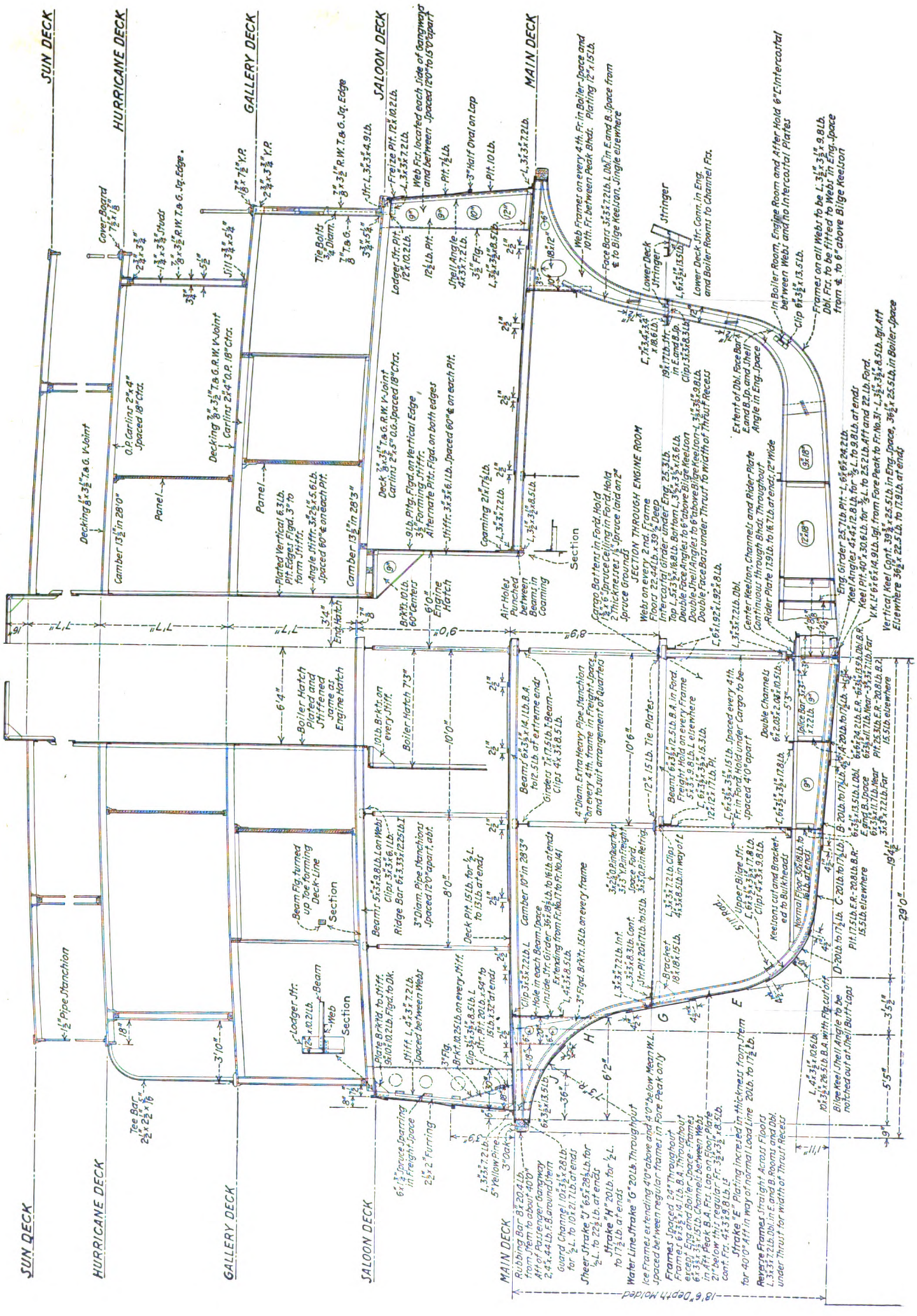


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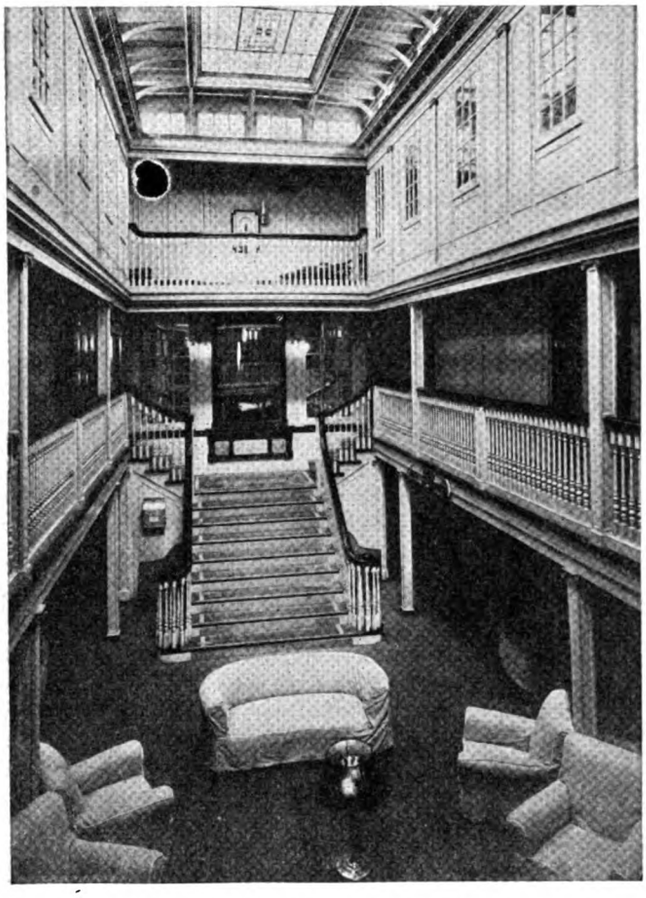
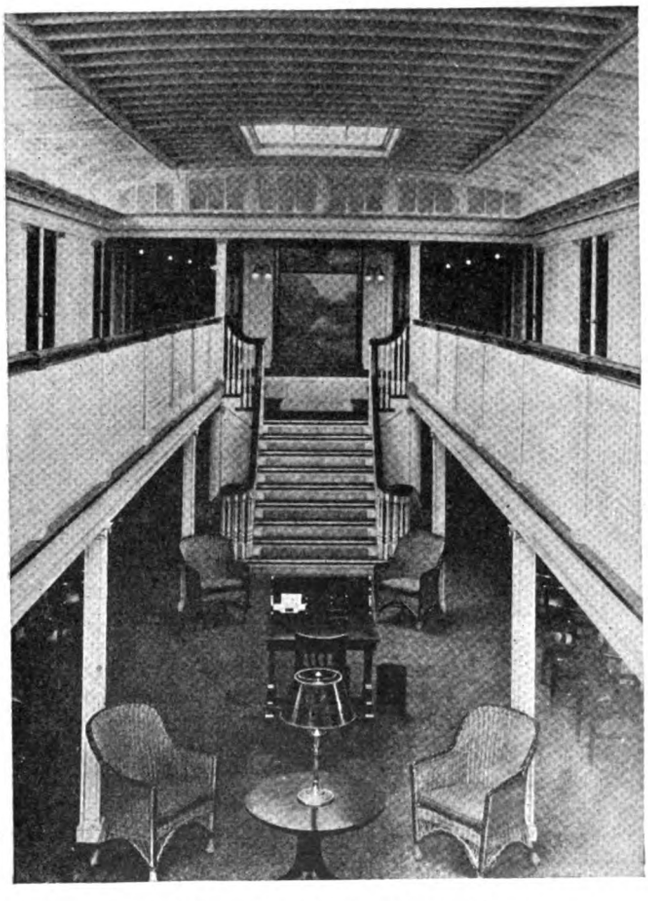
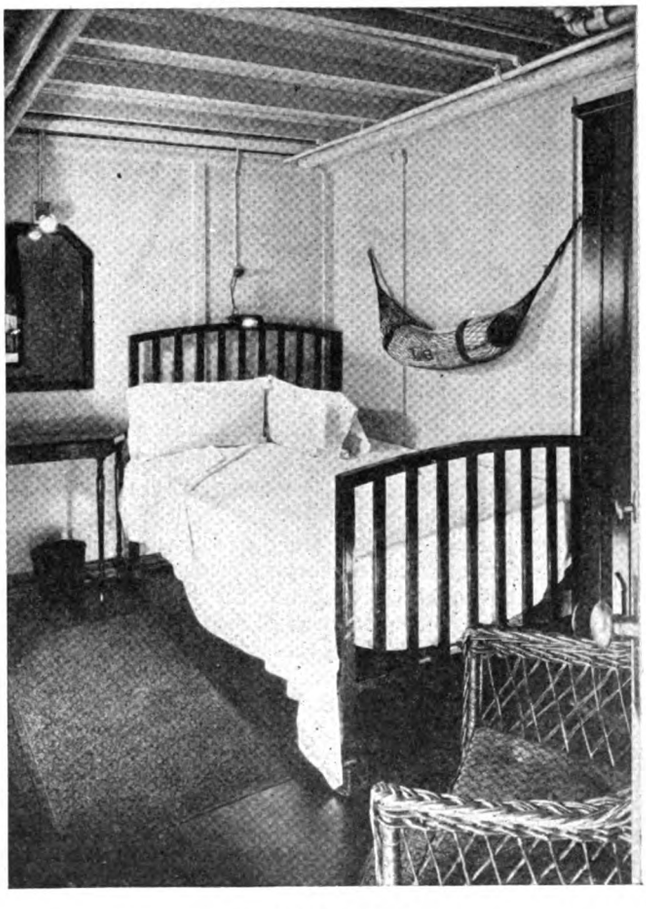


Forward saloon, looking aft

Forward saloon, looking forward



After saloon, looking forward



Typical stateroom

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gine, operating at 300 revolutions per minute, a direct connection being used.

The vacuum in the main condenser, which has a cooling surface of 4775 square feet, is maintained by a condensate pump of the vertical-twin type, 10 inches by 22 inches by 16 inches, made by the Warren Steam Pump Company, Inc., Warren, Mass. The main circulating pump, which was built by the Pusey & Jones Corporation, is of the centrifugal type, having a 12-inch suction and a 10-inch discharge, direct-connected to a 9-inch by 9-inch Engberg vertical steam engine. The remaining auxiliaries include:

2 Warren vertical-simplex main feed pumps, 12 inches by 18 inches by 24 inches
2 2-inch Schutte & Koerting injectors
1 Warren horizontal-duplex fire and donkey pump, 12 inches by 7 inches by 12 inches
2 Warren horizontal-duplex fresh-water pumps, 5¼ inches by 4¾ inches by 5 inches
2 Warren horizontal-duplex sanitary pumps, 7½ inches by 6 inches by 10 inches
1 Warren horizontal-duplex bilge pump, 7½ inches by 8½ inches by 6 inches
2 Warren horizontal-duplex hot water circulating pumps, 4½ inches by 2¾ inches by 4 inches
1 Reilly two-pass steel-shell feedwater heater, 25 inches inside diameter and 5 feet 7 inches high
1 Griscom-Russell straight-tube, steel-shell, three-pass hot water heater

The windlass, capstans and steering engines were supplied by the Hyde Windlass Company, Bath, Maine. Valves were supplied by the Crane Company, Chicago, Ill.; the Leslie Company, Lyndhurst, N. J., and Schutte & Koerting, Philadelphia, Pa. The lighting and interior communication systems were supplied by Charles Cory & Son, Inc., New York City.

### Results of Trials

On July 12, when the acceptance trials of the *President Warfield* were held, a total distance of 374 nautical miles was covered in a total sailing time of 22 hours. The mean speed for this distance was 17 knots or 19.57 statute miles per hour. During the trials in deep water, covering a time of 7 hours, the data for which appear in the table above, the draft forward was 9 feet 6 inches, aft 15 feet 4 inches, giving a mean draft of 12 feet 5 inches. The displacement was 2350 tons. The speed of 19.57 miles per hour developed by the *President Warfield* is somewhat higher than that of either of the sister ships, the accepted speed of which is 18.5 miles per hour.

During the trials the indicated horsepower readings showed a marked decrease in horsepower as compared with the sister ships. At the service speed of 18.5 miles per hour, it was noted that the *President Warfield* was using 900 horsepower less than the *State of Virginia* requires to maintain the same speed. This increase in speed at normal horsepower was aptly demonstrated when the *President Warfield*, leaving Old Point Comfort one-half hour after the *State of Virginia*, nevertheless docked next morning in Baltimore one hour ahead of the latter ship.

**Data Taken on Trial Run July 12, 1928**

| Time of Observation | R.P.M. | Log Readings: Tens | Units | Tenths | Knots | Speed: Knots | Miles | Gages: H.P. | M.P. | L.P. | Vacuum | Boiler Gages: Forward Port | Forward Stb'd | Aft Port | Aft Stb'd | Coal Counter Readings in Pockets (12 on floor) | I.H.P. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12:15 P.M. | 100 | 5 | 9 | 5.2 | 59.52 | | | | | | | | | | | | |
| 1:15 P.M. | 98 | 7 | 6 | 1.1 | 76.11 | 16.59 | 19.1 | 168 | 55 | 15 | 26 | 180 | 180 | 173 | 185 | 50 | 2224 |
| 2:15 P.M. | 99 | 9 | 3 | 0.0 | 93.00 | 16.89 | 19.45 | 158 | 52 | 13 | 26 | 165 | 168 | 161 | 173 | 59 | 2100 |
| 3:15 P.M. | 98½ | 10 | 9 | 4.5 | 109.45 | 16.45 | 18.94 | 158 | 52 | 13¼ | 25.8 | 170 | 170 | 165 | 175 | 62 | 2214 |
| 4:15 P.M. | 98½ | 12 | 6 | 5.5 | 126.55 | 17.1 | 19.68 | 158 | 53 | 13¼ | 26.4 | 165 | 168 | 162 | 173 | 66 | 2165 |
| 5:15 P.M. | 98½ | 14 | 3 | 5.1 | 143.51 | 16.96 | 19.52 | 162 | 53 | 13¾ | 26 | 170 | 172 | 165 | 177 | 76 | 2031 |
| 6:15 P.M. | 99 | 16 | 0 | 5.25 | 160.525 | 17.015 | 19.58 | 166 | 55 | 14½ | 25.9 | 178 | 176 | 170 | 185 | 87 | 2077 |
| 7:15 P.M. | 99 | 17 | 7 | 5.5 | 177.55 | 17.025 | 19.06 | 167 | 56 | 14¾ | 26.5 | 175 | 175 | 170 | 182 | 97 | 2274 |
| | | | | | | | | 167 | 55 | 14 | 26 | 175 | 175 | 170 | 181 | 101+ | 2214 |

# Bauer-Wach System Employed on Steamship Boniface

THE Booth Line freighter *Boniface*, the first vessel built for British owners to be fitted with the Bauer-Wach exhaust-turbine system, arrived recently at Brooklyn, N. Y., on her maiden voyage to South America. The *Boniface* was built by R. & W. Hawthorn, Leslie & Company, Ltd., Hepburn-on-Tyne, England. The vessel sailed from the Tyne on July 27, after her official trials, and arrived at Brooklyn on August 8, making an average speed of 12.2 knots with an average consumption of 0.5 pounds of coal per indicated horsepower hour.

The official trials, which took place on July 18 and 19, consisted of a six-hour run without the Bauer-Wach system in operation and six hours with the system functioning. The two series of trials were run under similar conditions of draft, weather and course. During the first six hours the mean indicated horsepower developed was 2963, the mean revolutions being 77.8. In the second six hours with the Bauer-Wach system in operation, the mean revolutions for the trial were 78.3, corresponding with an equivalent indicated horsepower of 3000.

Water measurements were taken for both series of trials. In the first six-hour run the water rate was 14.22 pounds and for the second series, with the Bauer-Wach system in operation, the water rate was 10.75 pounds. This represents a saving in steam consumption of 24½ percent for equivalent power in each case.

The main engines are of the triple-expansion, direct-acting, surface-condensing type, having cylinder diameters of 25½ inches, 43½ inches and 73½ inches, with a 51-inch stroke. The Bauer-Wach exhaust-turbine system is fitted in combination with the main engines.

Steam is supplied at 215 pounds per square inch pressure by three cylindrical boilers 16 feet 6 inches in diameter by 12 feet long, having a total heating surface of 9000 square feet. Superheaters of the Schmidt type giving 150 degrees superheat are also fitted. The boilers which are coal-fired employ the Howden system of forced draft. Soot blowers made by the Diamond Power Specialty Corporation, Detroit, Mich., are fitted to each boiler.

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# Passenger Liner Virginia Launched

## Second electrically-propelled steamship for Panama Pacific Line will be placed in service in December

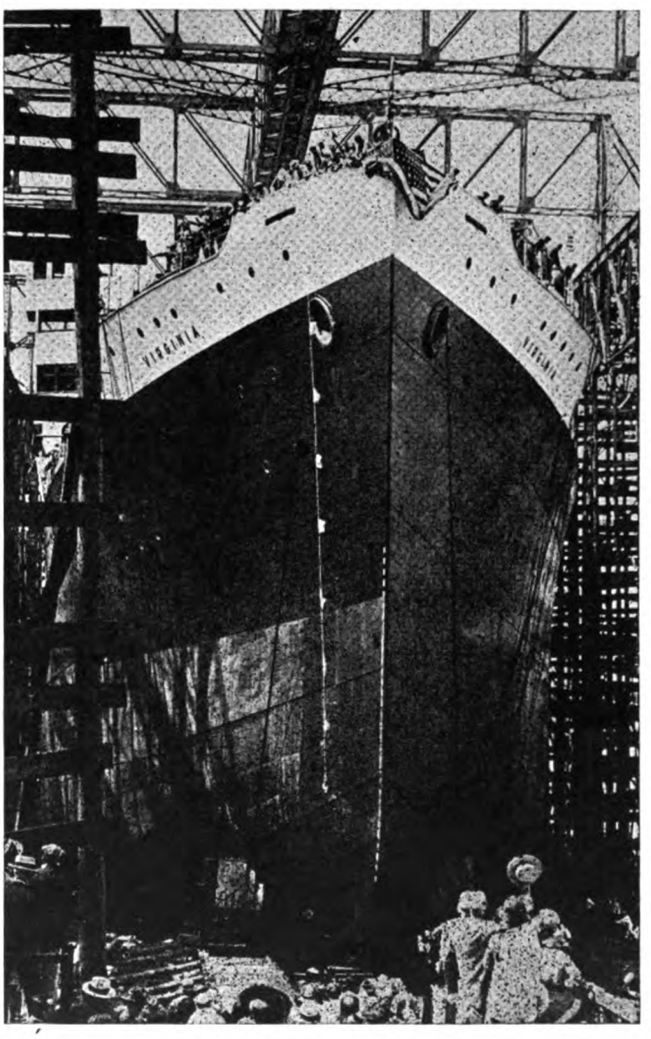
THE steamship *Virginia,* the second of three new turbo-electric passenger vessels which the Panama Pacific Line of the International Mercantile Marine Company, New York city, has ordered from the Newport News Shipbuilding & Drydock Company, was launched on August 18 at Newport News, Va. This event marks another stage in the company's plan to place in service the finest fleet of electrically-propelled passenger ships in the world. The vessel is scheduled to make her maiden voyage on December 8 of this year in the service operating between New York, Havana, Los Angeles, and San Francisco by way of the Panama Canal.

The *California,* first of the three ships, was commissioned in January 1928. The final vessel of the class, now under construction will be launched during the summer of 1929. The contract for the *Virginia* required the completion of the vessel on April 2, 1929, but the work of construction has progressed with such rapidity that delivery will be made four months in advance of the contract date.

The *Virginia* will be practically a duplicate of the *California,* except for an increase of 12 feet in length, the addition of 10 tourist rooms, and a different boiler room arrangement. Eight large watertube boilers, with interdeck superheaters will take the place of the 12 smaller ones on the first ship. The third vessel will be a duplicate of the second.

The *Virginia* is a twin-screw vessel designed to carry both passengers and freight, provision being made for handling a large amount of refrigerated cargo. Her extensive electrical equipment is being supplied by the General Electric Company, Schenectady, N. Y. She is being built to the highest classification of the American Bureau of Shipping.

The *Virginia* is designed for complete electric operation. The deck machinery, pumps, steering gear and freight hoisting winches as well as the propelling machinery will be electrically driven. An electric ventilating system will send cool air into every room when the ship is in warm latitudes, and an electric heating system will be used while the ship is being operated in northern waters.




**Steamship Virginia starting down the ways**

The principal dimensions are as follows:

| | |
|---|---|
| Length overall | 613 feet |
| Length between perpendiculars | 588 feet 9 inches |
| Beam | 80 feet |
| Depth to shelter deck | 52 feet |
| Depth to upper deck | 100 feet |
| Draft, loaded | 32 feet 3 inches |
| Displacement at load draft | 34,000 tons |
| Gross tonnage (about) | 25,500 |
| Shaft horsepower (maximum) | 17,000 |
| Shaft horsepower at cruising speed | 13,500 |
| Designed speed | 18.9 knots |
| Refrigerated cargo capacity | 100,000 cubic feet |
| First-class passengers | 400 |
| Tourist passengers | 400 |
| Crew | 350 |

Propulsion will be by two 8500-horsepower motors each driving a three-bladed manganese bronze built-up type propeller, 18 feet in diameter, 17 feet 9 inches pitch and weighing 39,000 pounds. The electricity for driving these motors will be produced by two Curtis-type, 16-stage, impulse steam turbines, direct connected to alternating-current generators. Each turbine will have a rating of 6750 shaft horsepower, 2460 revolutions per minute, the latter corresponding to a propeller speed of approximately 110 revolutions per minute. The maximum capacity of each turbine will be 8500 shaft horsepower, 2880 revolutions per minute at a propeller speed of 120 revolutions per minute. These turbines will be direct connected to alternating-current generators rated 5250 kilowatts, 2640 revolutions per minute, 3700 volts, 3 phase, and having a maximum continuous rating of 6600 kilowatts, 4000 volts.

The propulsion motors will be of the synchronous-induction type, rated 5250 kilowatts, 110 revolutions per minute, 3700 volts, 3 phase, 6750 shaft horsepower. The maximum continuous rating of each motor will be 6600 kilowatts, 120 revolutions per minute, 8500 shaft horsepower. These motors will be ventilated by four direct-current, motor-driven exhaust fans automatically controlled. In normal operation each fan will deliver 17,000 cubic feet of air per minute.

Steam for driving the turbines will be furnished by eight Babcock & Wilcox watertube boilers equipped



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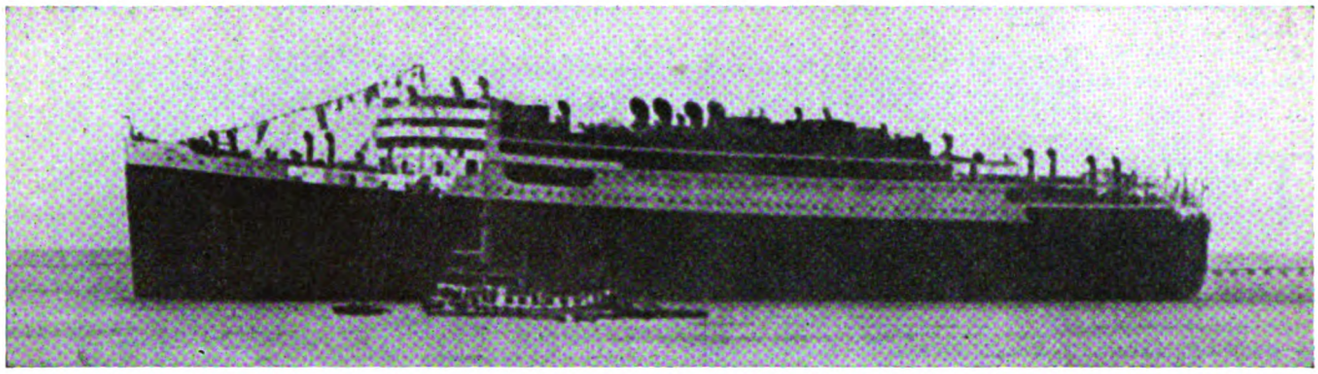

The Virginia after the launching

with inter-deck superheaters. The boiler pressure will be 300 pounds per square inch gage and the superheat 200 degrees Fahrenheit. These boilers will operate under forced draft with double front furnaces. Each boiler is fitted with six Babcock & Wilcox mechanical-atomizing oil burners of the Cuyamia design.

The exhaust steam will be condensed by a set of four condensers. Two main condensers for the main propulsion turbines will each have 11,000 square feet of cooling surface. Two smaller condensers, each with 2800 square feet of cooling surface, will condense steam from four 500-kilowatt auxiliary turbo-generators which will supply current for lighting and for excitation of the propelling motors.

The ship's rudder will be controlled by means of a hydro-electric steering gear. Two variable-stroke pumps manufactured by the Waterbury Tool Company, will supply fluid to Hyde Windlass Company steering gear plungers. The pumps are driven by two 75-horsepower, 400-revolution per minute, 230-volt, compound-wound, direct-current motors. Steering gear plunger controls will be located in the pilot house.

## Arc-Welded Crane

THE Cleveland Crane and Engineering Company, Wickliffe, O., announces, a new design of overhead traveling crane in which the bridge girders, end trucks and trolley are constructed by arc welding.

Fig. 1 shows a 5-ton, I-beam girder type crane with a span of 39 feet 9¼ inches. Each girder is reinforced throughout its entire length by angles arc-welded to the standard I-beam sections. The girders are attached to the end trucks by the notched or shoulder construction designed to prevent weaving. To facilitate shipping, the girders and trucks are disassembled. The field connection is made by bolts but additional arc-welded reinforcement is recommended to secure maximum rigidity.

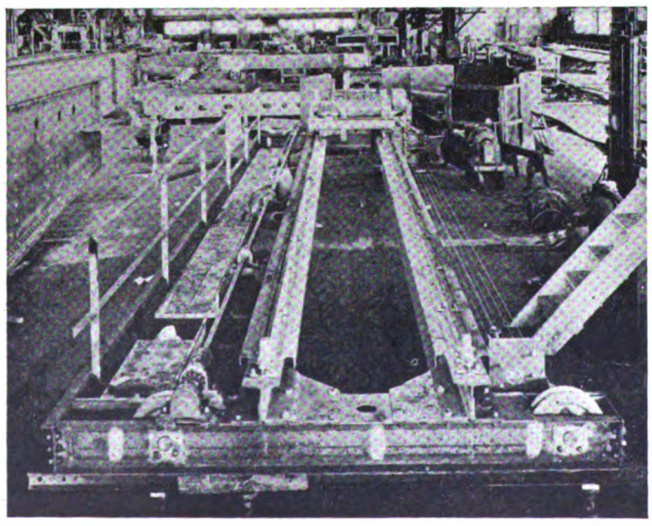

Fig. 1—General view of welded crane

The end trucks themselves are built up of two standard channel sections joined by arc welding. Roller bearings are used on this crane, permitting rapid acceleration and lower power consumption.

Two small standard arc-welded trolleys are shown in Fig. 2. Each trolley frame is made of a standard channel with arc-welded braces under each bearing point. Gear guards are arc welded as is also the hand rail on the foot bridge and the bearing supports for the bridge-drive shafts.

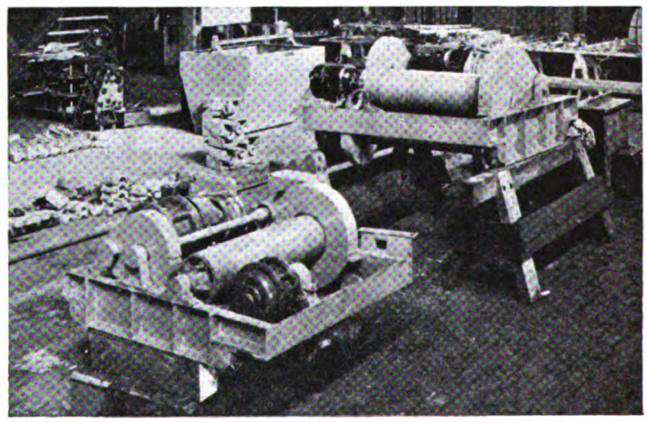

Fig. 2—Crane trolleys welded

All welding on this crane was done by the "stable-arc" process on machines furnished by The Lincoln Electric Company, Cleveland, O.

The advantage claimed for arc-welded crane construction, other than greater rigidity and strength, is that a more efficient distribution of weight is possible, thus making it possible to lighten certain moving parts and thereby to obtain greater acceleration.

COASTWISE LAWS.—President Coolidge on August 18 issued a proclamation deferring the extension of the coastwise laws to the Virgin Islands to September 30, 1929, on the ground that adequate shipping service to accommodate the commerce and the passenger travel of the islands has not been established, as provided by Section 21 of the Merchant Marine Act of 1920.

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# Trans-Atlantic Passenger Motor Ships

## Intermediate liners for the Hamburg-American, Swedish American, C. G. T. and White Star lines

By Our London Correspondent

AT the present time there are under construction in Europe six oil-engined liners destined exclusively for the passenger trade between New York and various European ports. Two more are projected and will probably be laid down before the end of the year so that within a period of 2 to 2½ years American passengers will have a choice of 11 motor liners for their trip to Europe should they be disposed to favor this new system of propulsion.

The fact that there should be more liners under construction for the North Atlantic passenger trade equipped with internal-combustion machinery than to be propelled by steam plant is a feature of interest, bearing in mind the strides which high pressure steam turbines have made, also the fact that there is a considerable difference in the prices of Diesel oil and boiler oil at New York at the present time. It would seem that the other advantages which motor propulsion is claimed to give, apart from the question of fuel, weigh considerably with owners, and there is no doubt that this is the case.

The first of the new liners to be completed will be the *Kungsholm* (the Swedish American Line's vessel now building in Germany), which will probably go into service in November or December. Then will follow two 16,000-ton Hamburg-American motor liners for the Hamburg-New York trade and next a 26,000-ton White Star intermediate liner which will be the biggest motorship in the world. The passenger ship which the Compagnie Générale Transatlantique is building will be completed in about a couple of years, and in addition there is the *Vulcania* which will reach New York at the end of December this year on her maiden voyage. She was not mentioned earlier as originally she was designed for South American service, and has been modified since launching in order to be more suitable for the North Atlantic trade. She is a Cosulich liner, similar in dimensions to the *Saturnia* but having considerable differences in internal accommodation.

### The Geared Diesel Hapag Liners

From the engineering standpoint, although the White Star liner *Britannic*, as she will be named, will have the highest powered machinery, the two liners for the Hamburg-American Line are, perhaps, the most notable. In the engine room, an entirely new system of propulsion is being utilized, and, if the claims that are made for this method are borne out in practice, they may cause a minor revolution in motor propulsion so far as it affects relatively big and fast ships.

It is well known in engineering and shipping circles that the objection most frequently urged against the oil engine for the propulsion of fast liners is that the weight, height, cost and space occupied by the Diesel machinery are considerable.

The builders reply to these contentions that the advantages outweigh the defects, also that the cost of machinery in a high-class liner does not represent relatively so large an item as in cargo ships, and, finally, that the weight is a comparatively unimportant factor. Be this as it may, if the weight, size and height can be reduced, there is no doubt that the oil engine would have an added attraction to the liner owner in search of the most suitable class of machinery for his new tonnage.

In the new Hapag liners *Milwaukee* and *St. Louis* an attempt has been made in this direction, apparently with a considerable degree of success, although some Diesel engineers might doubt the method that has been employed.

### High-speed, Double-acting Engines

The machinery power required for this 16,000-ton, 16-knot liner is 12,600 shaft horsepower. To obtain this, four engines have been installed operating at the high speed of 215 revolutions per minute and each pair is coupled to a common propeller shaft through reduction gearing, which brings down the speed of the propellers for normal operation to 110 revolutions per minute. The gearing is direct coupled to the engines.

This in itself is novelty enough but perhaps more interesting is the employment of double-acting, two-stroke motors, the first of the high-speed design that have ever been fitted on a ship.

The net result of the adoption of this somewhat bold plan may be noted. In the first place, the total weight of the four engines, exclusive of the gearing, is about 600 tons, which is, of course, much lower than the normal. Secondly, the height from the top of the upper fuel valve to the center of the crankshaft is 25 feet, which probably represents a saving of 10 feet, compared with the height that would be necessary with four-cycle, double-acting, twin-screw plant. In fact, 35 feet is about the height of the engines of the *Gripsholm*, each of 6750 brake horsepower. The length of the engine room of the *St. Louis* and *Milwaukee* is also moderate, being about 70 feet, including large bunker side tanks, but excluding the auxiliary engine room.

The low height enables a very satisfactory accommodation arrangement to be worked in. The engine room only breaks into the two lowest decks—Nos. 3 and 4 decks—and, above the latter, no break occurs, apart from the casing enclosing the exhaust pipes and ventilating pipes. Part of No. 3 deck at the sides is also available for the accommodation and the arrangement is probably quite as satisfactory from this aspect as could be attained with steam turbines.

Although the propelling machinery will be of the high-speed type, the piston speed will not be above the normal. The bore and stroke of the six cylinders are 485 millimeters and 660 millimeters respectively. This gives a piston speed of 930 feet per minute, which is very moderate and is, for instance, very much lower than that of the Burmeister & Wain double-acting, four-stroke engines in the *Gripsholm* and *Saturnia*. As piston speed is the vital factor in Diesel engine operation, it is claimed that the fact that the engines turn at 215 revolutions per minute is no detriment whatever, in view of the low piston speed.

The engines have the usual M.A.N. double-acting,



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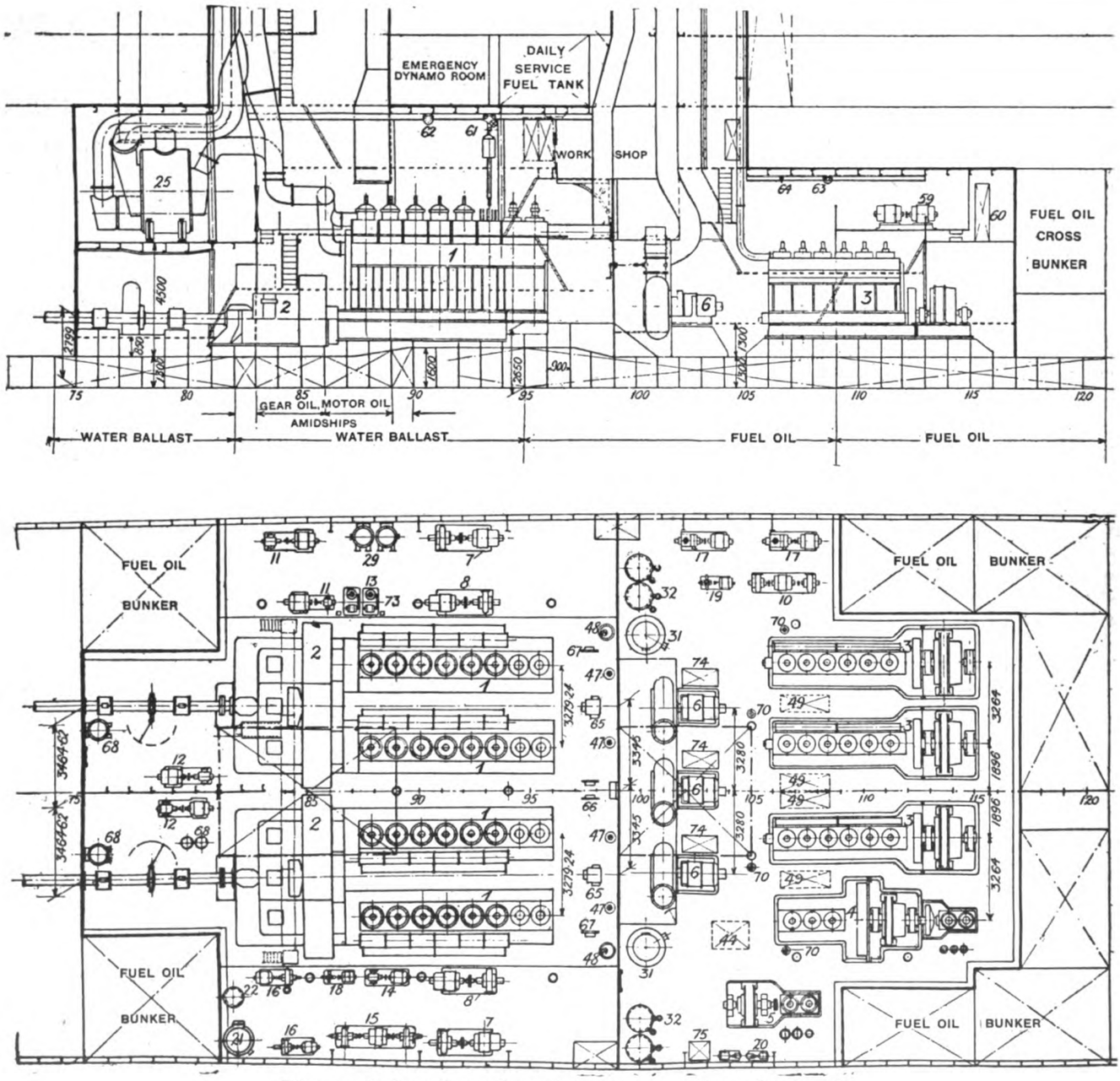
two-stroke features, including fresh-water cooling for the pistons and cylinders but they are fitted as air-injection motors. It was not thought advisable to adopt airless injection (although it would have given a lower fuel consumption), until more experience had been gained but, incidentally, it is noteworthy that trials have just been carried out on a 12,000 brake horsepower engine of a similar class for stationery purposes, in which the airless-injection method is adopted.

### Auxiliary Machinery

The auxiliary generating machinery is installed in a separate engine room forward of the propelling plant and bulkhead off from it. There are four Diesel-driven sets, three of them being six-cylinder units driving 450 kilowatt dynamos and the fourth a three-cylinder Diesel engine of similar cylinder dimensions, coupled to a 225-kilowatt dynamo and to an air compressor, for the supply of starting and maneuvering air. Conforming to modern standards, the exhaust gases from the propelling engines are arranged to pass through the boilers to raise the steam which is necessary when the ship is under way. These boilers can be oil-fired when required. Fuel oil is carried partly in deep tanks at the sides of the engine room and forward of the auxiliary machinery space, and partly in double-bottom tanks under the auxiliary engine rooms. It is estimated that the daily fuel consumption will average 50 to 55 tons for all purposes, when making a speed of about 16 knots.

### A White Star Motor Liner

In view of the uncertainty which exists regarding




Plan and elevation of engine room on liner St. Louis

1—Four main engines. 2—Gearing. 3—Three 450-kilowatt Diesel dynamos. 4—One Diesel dynamo with compressor. 5—Auxiliary compressor. 6—Three scavenging blowers. 7—Two sea-water pumps. 8—Two fresh-water cooling pumps. 9—Two water coolers. 10—One sea and fresh-water cooling pump. 11—Two lubricating oil pumps for main engines. 12—Two lubricating oil pumps for gearing. 13—Two lubricating oil separators. 14—One daily supply fuel pump. 15—One trimming pump for ballast and fuel. 16—Two Lentz pumps. 17—Two fire pumps. 18—One warm sea-water pump. 19—One warm fresh-water pump. 20—Two water pumps. 21—One bilge-water separator. 29—Two oil coolers for main engine. 47—Four injection air reservoirs. 48—Two spare injection air reservoirs. 68—Two oil coolers. 70—Four oil coolers.

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the type of propelling machinery to be fitted on the 60,000-ton White Star liner that has just been laid down, the fact that a 26,000-ton intermediate liner for the same owners will have oil engines is of some importance.

The *Britannic,* as the new ship will be named according to present intentions, will be 710 feet long with a beam of 75 feet and a depth of 52 feet 6 inches, and, like the *Milwaukee* and *St. Louis* (which are 540 feet long with a beam of 72 feet), will have accommodation for cabin and third-class passengers only. She is intended for a service speed of about 17 knots and has a gross tonnage of 26,000.

The machinery will comprise Harland-Burmeister & Wain double-acting, four-stroke motors, and they will be ten-cylinder units, the first with this number of cylinders yet built. The cylinder dimensions, however, will be identical with those of numerous vessels already constructed, including the Royal Mail Steam Packet Company's *Asturias* and *Alcantara,* the Swedish American Line's *Gripsholm* and the Cosulich Line's *Saturnia.* The diameter is 840 millimeters and the piston stroke 1500 millimeters and the normal output of each engine is intended to be in the neighborhood of 20,000 shaft horsepower.

The *Kungsholm* will be very much an enlarged *Gripsholm.* She is 608 feet overall with a beam of 78.1 feet and the gross tonnage is 19,500. The service speed is to be 17 knots and two 7500 brake horsepower Burmeister & Wain engines are installed, with cylinder dimensions equal to those of the engines of the *Britannic* but with eight cylinders. It is of some interest to note that the speed of the engines is to be 100 revolutions per minute against the designed speed of the *Gripsholm's* motors of 125, which was found to be somewhat higher than desirable.

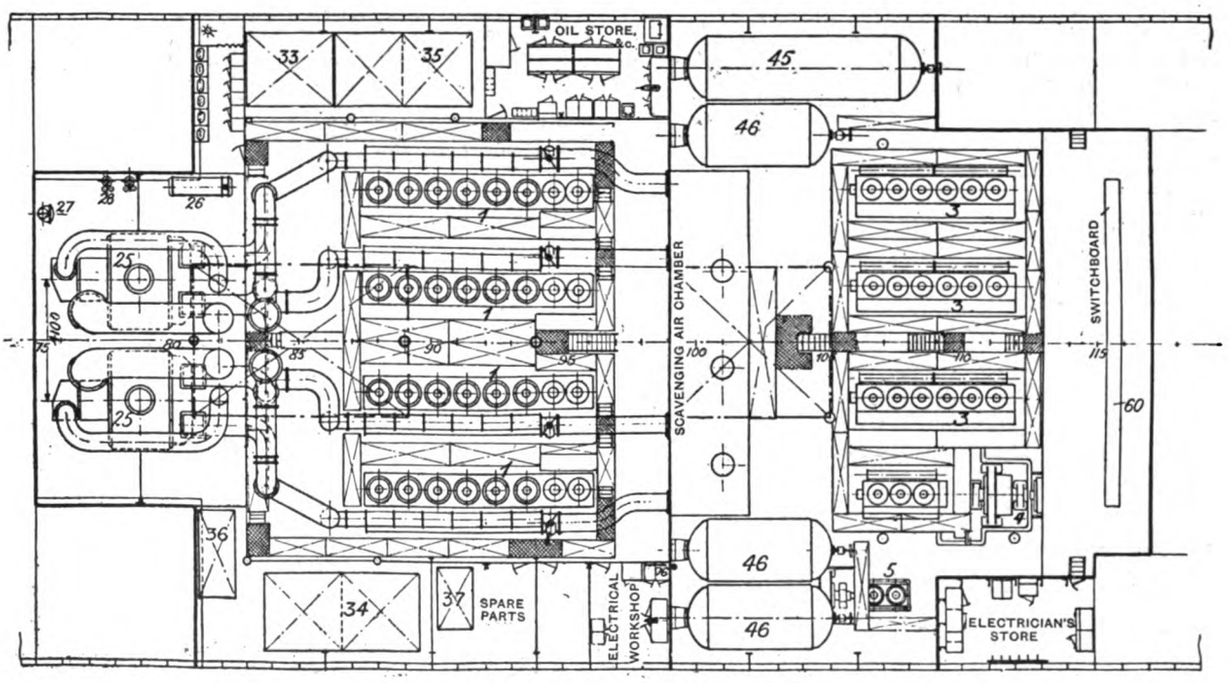
The Compagnie Générale Transatlantique's liner will embody still another propulsion system. She will be a vessel 574 feet long with a beam of 75 feet 6 inches and will have quadruple-screw machinery. There will be four double-acting, two-stroke M. A. N. engines, each developing 4000 brake horsepower and having six cylinders 600 millimeters bore with a piston stroke of 900 millimeters. In this ship the speed will be 145 revolutions per minute, which seems somewhat high for direct drive, since the vessel's speed is to be 17 or, at the most, 18 knots.

Finally, the *Vulcania,* so far as the propelling machinery is concerned, will be a sister ship to the *Saturnia,* details of which are known, and which has the special interest that it is the only big passenger liner equipped with double-acting, four-stroke supercharged machinery.

Mention was made above of the fact that the Swedish American Line and the Scandinavian American Line would both order a motor passenger liner before the end of the year. That for the Copenhagen firm will be an interesting ship, since she will be a vessel of 20,000 tons gross and will have machinery of about 22,000 indicated horsepower. It is understood that four-stroke, double-acting Burmeister & Wain engines will be installed and the intention is to have quadruple screws. The vessel will thus represent the first liner of the quadruple-screw type to have machinery of this class.

### Third Ship for Swedish Line

The third ship for the Swedish American Line will probably be somewhat larger than the *Kungsholm* and may be 22,000 or 23,000 tons gross. This will involve the installation of higher-powered engines, and it will not be altogether surprising if, in the vessel, an entirely new system is employed. At any rate, it may be said without question that, so far as the propulsion of big passenger liners is concerned, the design of suitable Diesel machinery has, as yet, by no means been standardized, and, out of the welter of the various types, possibly one may be evolved which will clearly prove superior to the others. But of this there is, as yet, no evidence.




**Plan of engine room on 4th deck of liner St. Louis**

25—Two exhaust-gas boilers. 26—One auxiliary condenser. 27—One evaporator. 28—Two boiler-feed pumps. 45—One main starting air reservoir. 46—Three starting air reservoirs.

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# Electrical Equipment of Submarines V-5 and V-6

By C. T. Pearce*

THE main electrical equipment of the two new fleet-class submarines *V-5* and *V-6*, now under construction for the United States Navy, has recently been completed by the Westinghouse Electric & Manufacturing Company. These submarines will be the largest of the V-class craft yet built.

The vessels are of the twin-screw type, Diesel engines being used for propulsion on the surface and direct-current motors, fed from lead storage batteries,

**Fig. 1.—Port motor, viewed from inboard side**

for submerged operation. These batteries may be charged either from the propelling motors, acting as generators, or from Diesel-driven auxiliary generators furnished for that purpose.

## Arrangement of Machinery

The motors and engines will be located in the after part of the vessel, in the motor room and machinery space, respectively. The motors will be installed aft of the engines, their shafts being clutched at one end to the propeller shaft and at the other end to the engine shaft. Obviously, each engine drives a propeller through the motor shaft. When electric drive is used, the engine may be de-clutched from the motor; when the engine is being used solely to drive the motor as a generator for battery charging purposes, the propeller shaft may be de-clutched from the motor.

Each motor is of the double-armature, commutating-pole-direct-current, shunt-wound type with the shunt

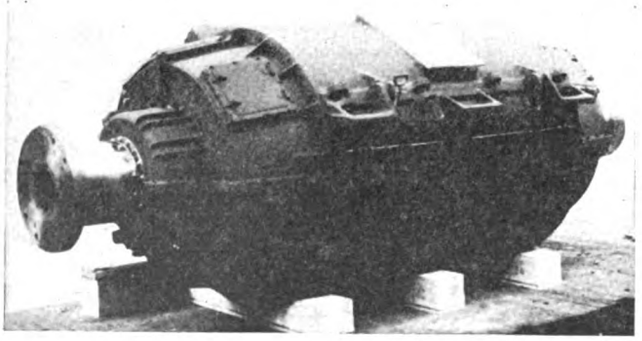

**Fig. 2.—Port motor, viewed from outboard side**

fields arranged for separate excitation from the battery. The motor is fully enclosed and watertight. It is arranged for forced ventilation from a separate source. Each motor is a self-contained unit with two bracket bearings. Views of the assembled port motor are shown in Figs. 1, 2, and 3. The appearance of the starboard motor differs from that of the port motor only in that the coupling flanges, shown on the opposite ends of the shaft, are interchanged.

The motor is designed to accommodate a great number of ratings, depending upon the speed and service required. Normally the four armatures, which go to make up the two double-armature motors per ship, are connected in parallel. By connecting all four armatures in series and increasing the field excitation to its maximum value, it is possible to reduce the motor speed, thereby giving the vessel slow speed for maneuvering purposes.

The battery is divided into two groups. One group will be located aft in a special compartment and the other will be located forward. The two groups will be connected in parallel so that the voltage across the two motors will always lie at some value between 195 and 240, depending upon the condition of the battery and the rate of discharge. Each motor is capable of being used as a generator to charge the battery. For higher amperes and low voltage, the two armatures are connected in parallel. For supplying the finishing charging current at a lower rate and higher voltage the two armatures may be connected in series.

## Construction of Motors

A radical departure from conventional methods has been made in the design and construction of these motors. In a submarine, weight and space are naturally at a premium. Consequently the motors are designed in such a manner as to obtain the greatest possible amount of energy per unit weight and volume of material. Mica and asbestos are used throughout for insulating purposes, as they are capable of withstanding a much higher temperature than the organic insulating materials ordinarily used in direct-current motors of this size.

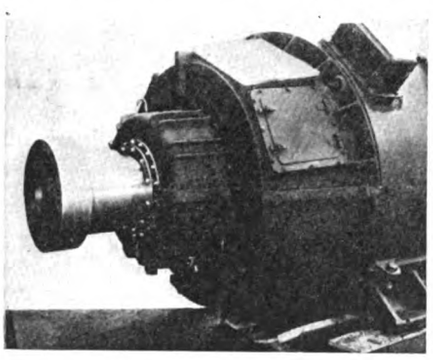

**Fig. 3.—Port motor, viewed from inboard side at propeller end**

As an additional means of conserving weight and space, forced ventilation is used. This, of course, permits a considerably greater output from a given volume of material than can be obtained where natural ventilation is relied upon to dissipate the losses generated in the machine. A closed-ventilating system is used, the air being cooled by passing through a special sea-water cooler.

The height of the motor space is unusually restricted. For this reason, the motor is not only made double armature but each armature has a ratio of diameter to length which is considerably lower than that usually encountered in motors of this size.

Since reliability and continuity of service are of supreme importance in this installation, only the finest materials were used in the construction of these motors. All materials which went into the manufacture of these machines were subjected to the most rigid tests and inspections. With the exception of the insu-

* General Engineering Department, Westinghouse Electric & Manufacturing Company.

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lating material, the parts devoted to carrying current and those which are not subjected to mechanical stresses, the machine is constructed entirely of steel, either cast, forged or punched. As they carry no appreciable mechanical stresses, the upper halves of the bearing housings and bearing brackets are made of an aluminum alloy in order to reduce weight.

It is essential to have ready access to the various parts of the motor after installation, especially those parts which experience has shown are most liable to need repair or replacement. As it was impossible to provide sufficient clearance aboard the vessel to permit the complete dismantling of the motors, it was necessary to incorporate several special features of accessibility in the motor design. The two rotors and stators, forming one motor, are mounted inside a cylindrical cradle, the rotors being mounted on a common shaft, which is supported in two bracket bearings. This cradle is split at 30 degrees below the horizontal center line on the inboard side and hinged on the outboard side, as shown in Fig. 4. The two stators are normally doweled to the cradle and supported, from each end, by ribbed

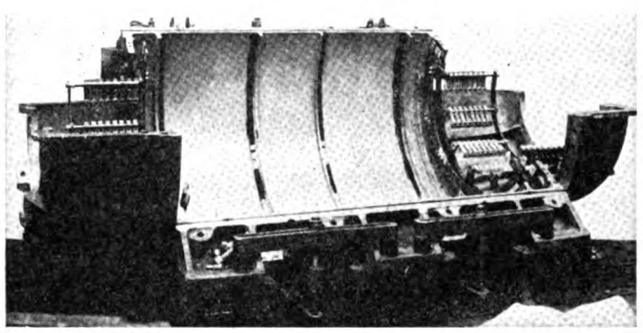

**Fig. 4.—Lower halves of motor cradle, bearing brackets and brush rigging**

projections on the inside surface of the cradle. Each stator is equipped with brass rings on either end for the purpose of providing bearing surfaces. Gear teeth are machined in the exact center of each stator which, in conjunction with a worm gear and ratchet wrench attached to the lower half of the cradle, provide means for shifting the stator to any desired angular position. Thus, in case an injury develops to any field coil, it is necessary only to open up the cradle a few inches at the inboard side of the split, remove the dowels holding the stator to the cradle and rotate the stator carrying the injured coil to a position where the coil may be removed through the space created for that purpose at the inboard cradle split, after which it may be repaired or replaced.

The brush rigging is mounted on a cylindrical ring which has teeth machined on its outside surface. This, in conjunction with a gear and ratchet wrench arrangement which is attached to the cradle, provides a means of rotating the brush rigging to a point where any brush or brush holder is accessible from the upper inboard side of the commutator. Part of the brush rigging is visible in Fig. 4.

The motor bearings are quite special and are the result of considerable development and engineering effort. This bearing has an unusually large ratio of diameter to length, the principal reason for this being that the shaft is sufficiently large to transmit the full engine

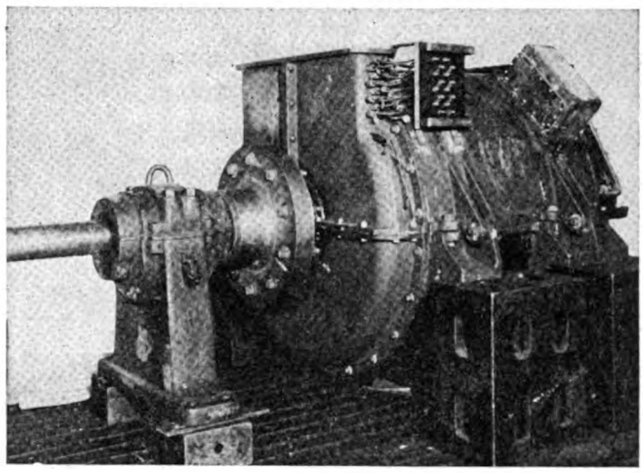

**Fig. 5.—Port generator, viewed from coupling end**

torque. It is designed to permit the operation of the motor for one-half hour with the shaft inclined 30 degrees from the horizontal in either direction, in order to satisfy the requirements of diving service. This bearing is equipped with a central disk, secured to the shaft, which performs the dual function of keeping the oil in circulation and transmitting the thrust obtained under inclined operation to special thrust blocks which are imbedded in the lower halves of the bearing on either side of the disk. This is a self-alining bearing and special features are incorporated in its design which insure a continued supply of oil to the bearing surfaces under conditions of pitch and roll of the vessel. In order to make the bearing as small as possible, water cooling is used. Specially constructed packing glands are provided at both the outer and inner ends of the housing to prevent the leakage of oil or the entrance of water.

### Auxiliary Generators

As mentioned before, two engine-driven auxiliary generators are supplied with each ship to charge the batteries or to furnish power to the main motors or auxiliaries. These generators, with their engines, will be located in the pump room, which lies amidships. Each generator is of the single-armature, commutating-pole, direct-current, shunt-wound type, with the shunt field arranged for either self excitation or separate excita-

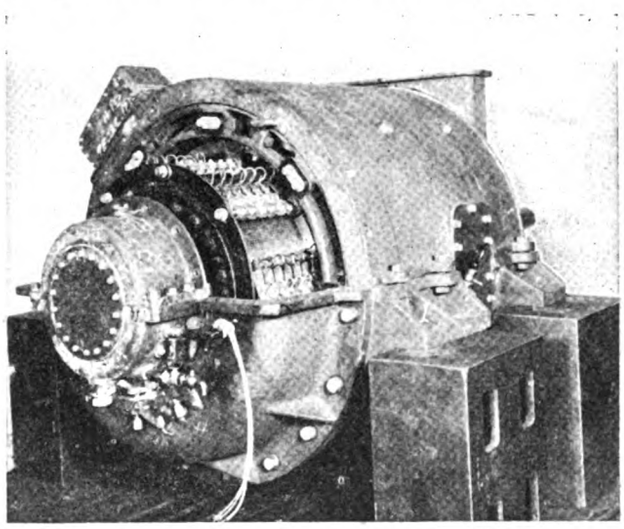

**Fig. 6.—Generator, with upper half of end bell removed**

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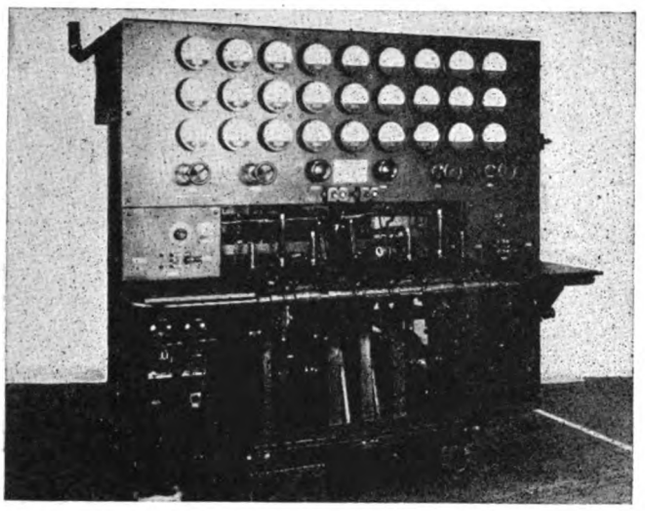

**Fig. 7.—Front view of control, showing operating levers**

tion. The generator is fully enclosed and watertight, and is arranged for forced ventilation from a separate source. It is equipped with only one bracket bearing and arranged for coupling to the Diesel engine on the opposite end. Figs. 5 and 6 show the port generator. The appearance of the starboard generator differs only in that the bearing and commutator appear at the opposite end with respect to the rest of the machine.

The generator is much smaller than the motor and, being single armature with only one bearing, is of somewhat simpler construction, although it has the same features of reliability, accessibility and high output per unit of material. The generator bearing is not required to carry the thrust of its own weight under inclined operation, but is designed to lubricate satisfactorily under conditions of inclined operation.

## Control

The main control scheme utilized incorporates reliability and flexibility to the highest degree. It makes possible the accomplishment of the following functions:

(a) Start, stop, reverse and regulate the speed of the motors.
(b) Provide for the series, parallel, or series-parallel operation of all main-motor armatures.
(c) Provide gradual changes in speed for each main motor through the entire range from the minimum obtained with all armatures connected in series and maximum field excitation to the maximum speed with all armatures connected in parallel and minimum excitation.
(d) Provide for use of motors in starting their respective engines.
(e) Provide for charging one or both batteries by either main motor.
(f) Drive with two main engines and charge batteries with two main motors.
(g) Drive with one main engine and charge batteries with the other main engine and motor.
(h) Charge batteries with one main engine and motor (tail clutch out) and electric drive with the other main motor (main-engine clutch out).
(i) Drive with one main engine and electric drive with the other main motor (main-engine clutch out) and charge batteries with auxiliary engine generators.
(j) Drive with one or two main engines and charge battery with auxiliary engine generator.
(k) Drive with two main engines, auxiliary engines and battery.
(l) Drive with one main engine and drive electrically with the other main motor, using auxiliary engines and battery.
(m) Drive with auxiliary engine and charge battery.
(n) Drive with either or both groups of the battery in parallel.
(o) Supply power and lighting with auxiliary generators, with battery totally disconnected.

Considering that it makes possible the accomplishment of all of the above functions, the control equipment is amazingly simple in arrangement and operation. All switching operations are accomplished manually, thereby obviating the complication of intermediate control mechanism, either electrical or pneumatic.

The main control apparatus consists of 28 large cam-operated switches, arranged in a steel structure and divided into six switch groups. These switches, all of which are duplicate and interchangeable were developed for this particular application. Their design incorporates magnetic-blowout and trip-free mechanism. The rating of each switch is such as to carry the rating of one armature continuously, two switches being connected in parallel where the current of a complete motor or battery is to be handled. Figs. 7 and 8 give different views of the switch groups completely assembled with the operating desk and meter panels.

Each of the six switch groups is actuated by a single cam shaft, which is in turn operated, through various levers and bevel gears, by a handle or handles located at the operating desk. Fig. 7 shows that the operating desk is equipped with eight handles.

The two outside handles operate, through a system of levers, the field-reversing switches of the port and starboard motors, respectively. These switches, as the name implies, are used to reverse the direction of rotation of the main motors and are located on separate panels just back of the operating desk.

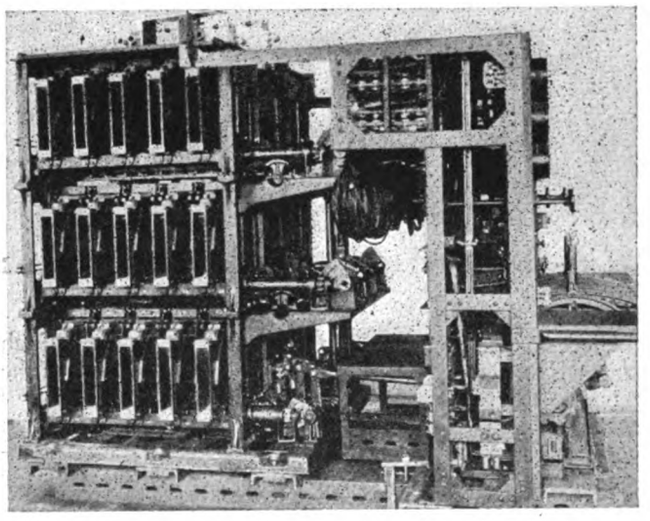

**Fig. 8.—Side view of control, showing arrangement of operating mechanism**

The remaining six handles or levers are used to operate the six main switch groups. The two levers on either side, adjacent to those just described, operate the starting-switch groups of the port and starboard motors, respectively. By means of these levers, it is possible to accelerate, using armature resistance, the two armatures of any motor in either the series or parallel position.

The two levers directly to the right of the center line of the operating desk are used to select and close the switches of the after and forward batteries. These switch groups are closed in two movements. First the cam shaft is shifted longitudinally to the desired position by a selector lever, then the switches are closed with a single movement of the operating lever mounted adjacent to the selector lever. By means of these levers, it is possible to feed from either battery group or both battery groups in parallel.

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The remaining two levers, directly to the left of the center line of the operating desk, are used to operate the switches which determine the connection that is to be used between the two motors. These switches are known as the motor-selector switches and operate similarly to the battery switches in that they require the manipulation of a selector and operating lever. Through these levers, it is possible to operate either motor alone, both motors in parallel or both motors in series, or drive either motor from the other operated as a generator.

By manipulation of the motor-starting and selector levers, it is possible to place the four armatures, going to make up the port and starboard motors, in the series, series-parallel, or parallel position, thereby providing three basic speeds. Between these points, speed variation is secured by the field rheostats.

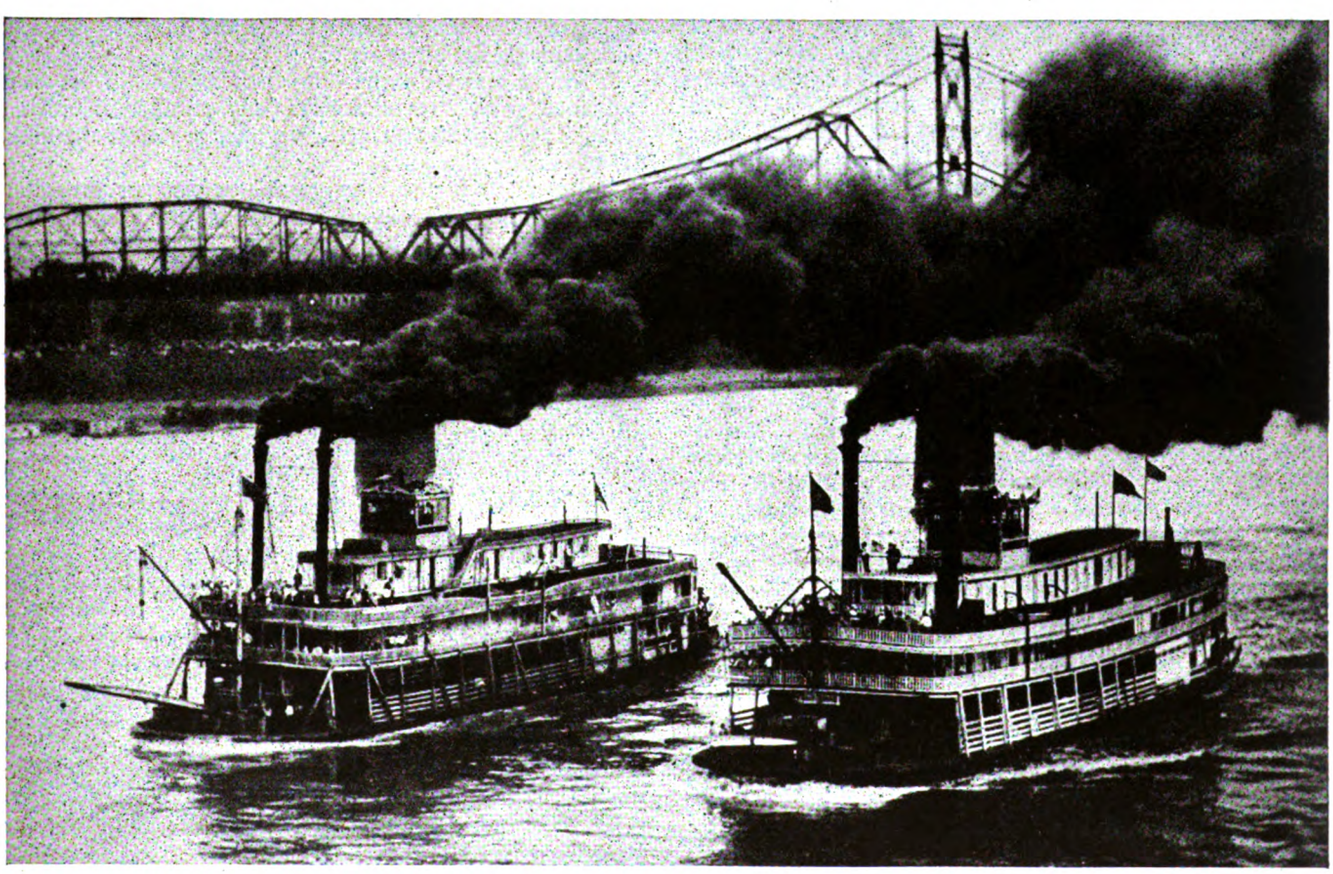
Interlocks are provided, usually mechanical, which make it necessary to perform any switching operation in the following sequence: First the field-reversing switches must be closed to the ahead or back position as desired and the field currents built up to their maximum value. Then the desired battery is chosen with the battery-operating lever. Next the desired motor is selected by means of the motor-selector and operating levers. Finally, by manipulation of the motor-starting levers, the motors are brought up to speed in either the series or parallel position as desired. No operating lever can be closed unless the corresponding selector lever is in one of the running positions and the selector lever cannot be closed unless the corresponding operating lever is in the "off" position. Another interlock is provided which prevents a field switch being opened without first opening the motor-starting switch.

Each main motor is provided with both a hand-operated and automatic load-balancing device to insure proper load division between the two armatures when operating in parallel. This mechanism is operative only under conditions of switching surges or sudden load changes, the motors being inherently load balancing under normal operating conditions.

When used for battery-charging purposes, the motors are connected to the desired battery or batteries and the voltage adjusted, by means of the field rheostat, until the desired charging current is obtained.

Overload protection is provided in both the motor and battery circuits. In case an overload occurs in a battery circuit, all switches are tripped immediately, but there is a time-delay arrangement, used in conjunction with the motor overload-protection scheme, which precludes the tripping of the main switches upon the occasion of momentary load surges in the motor circuits such as might be caused by the performance of a switching operation. The tripping of switches under overload is accomplished by means of a special magnetically-operated trip mechanism incorporated in the design.

The auxiliary generators are connected to the batteries through two sets of carbon circuit breakers, one set being located in the pump room and the other on the main control panel in the maneuvering room. It is possible to disconnect the batteries entirely and drive the motors direct from the auxiliary generators.



**Packet boats race for Ohio River record**

**The Betsy Ann (left), and the Chris Greene (right), Ohio River packet boats, which recently raced from Cincinnati to New Richmond, Ohio, a distance of 22 miles up stream against an unusually stiff current. The Chris Greene, practically a new boat, won by several lengths from the Betsy Ann, 30 years old and a veteran of the lower Mississippi, where she once won a set of gold tipped elk horns as a trophy in a speed race. This trophy was surrendered to the Chris Greene after the race.**

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# Fundamentals of Screw Propellers

## Practical methods for measuring the pitch of a propeller and for setting the blades

By David Gaehr*

ALTHOUGH the screw propeller has been used for over a century for ship propulsion (historians accredit John Fitch with having developed the first screw-propelled ship in 1796), its function still seems to be something of a mystery for many an operating engineer and for such individuals this article is intended.

Fitch's screw, which worked, was a continuous spiral of about three turns. A study of this device involves most of the elements and definitions applying to screw threads, to screw conveyors (still used extensively in grain elevators, etc.), and to screw pumps. While all kinds of "high-brow" terms have been applied to the screw propeller by scientific men, yet the essentials are those with which any mechanic is quite familiar. The fundamental principles of the helix or spiral alone need concern the operating engineer.

### Basic Elements of the Screw

A spiral, as in the case of a screw thread, may be produced by wrapping a triangle of paper around a cylinder and marking the curve made by the hypothenuse. Make sure that the altitude, which is the pitch, is parallel to the axis of the cylinder and that the base of the triangle is equal to the circumference of the cylinder. The pitch then is the measurement from the top of one thread to the top of the next one, taken along a straight line parallel to the axis of the cylinder, provided it is a single thread that is being measured. It is also the advance that the screw makes in one revolution, when turning in a fixed nut (or the advance the nut makes on a fixed screw in one revolution).

Often it is necessary to have a much greater advance in one revolution than is attainable by the use of standard threads. Since the depth of a thread of a given form has a very definite relationship to its pitch, increasing the latter without correspondingly increasing the diameter of the cylinder cuts into and weakens the material at the center. The necessity for retaining the diameter and the structural strength when so increasing the pitch led to the use of multiple threads—double, triple, quadruple, etc., up to as many as eight in common practice. All threads are alike and evenly spaced, the aggregate effect being the same as though there were but one thread, except in point of strength. In this connection, if the entire load were carried on one thread of a multiple-thread screw, it would probably shear off the body of the screw, whereas greater loads and thrusts can be borne by the combination of threads. In machine shop parlance the pitch of a multiple-thread screw is still taken as the distance from one thread to the next. The lead is the advance the screw or nut makes in one revolution, either one being fixed. According to this conception, pitch and lead mean the same thing only in the case of a single thread, or single-helical surface.

These considerations of screw-thread characteristics apply to Fitch's screw, which was developed into multiple-helical surfaces. Experimentation with this screw brought out the fact that even better results could be obtained if, instead of helical surfaces of several turns, only fractions of one turn, in the form of blades, were used, each blade being part of a different helix. The shapes and curvatures of these blades are still subjects of investigation. For a number of years, however, they have maintained the familiar form, pear-shaped or egg-shaped in projection.

### Pitch Measurements

While the designer determines the pitch of the "wheel" for a given hull and desired speed, the operating engineer must be able to set new blades correctly whenever replacements are required because of breakage or other damage. In this connection the main thing to do is to set all of the blades alike and to avoid vibration. It must be remembered that, inasmuch as the pitch varies at different distances from the shaft (radially-expanding pitch) and often varies across the blade at the same distance from the shaft (axially-expanding pitch), the pitch measurements at any given point are not necessarily the "pitch of the wheel." This is in reality an average of many measurements taken and considered in relation to the areas having such pitch. However, a measurement taken close to the tip of the blade, or near the widest part of the blade is usually close enough for all practical purposes.

A simple way of expressing the relationship between "advance" and "revolutions" (i.e., another definition for pitch) indicates at once various practical methods of measuring pitch:

If the pitch is the advance the screw (or propeller blade) would make in an unyielding medium in one complete revolution of that screw, then in a certain fraction of one revolution the advance would be the same fraction of the pitch as the fractional revolution is a part of the whole revolution.

For instance, in half of one revolution of the propeller shaft the advance would be half of the pitch; in a quarter of a revolution it would be a quarter of the pitch; in a tenth of a revolution it would be a tenth of the pitch, etc. When this fraction of a revolution is so small as to correspond to so small a section of that helical (or spiral) surface as that of the blade itself, then, evidently, the "fractional pitch" (advance in the direction of the shaft) between any two points on that blade surface equidistant from the center of the shaft can be measured. The fraction of a revolution, which a radius of a circle would make between these two points, projected onto the "disk area," can also be measured.

The determination of this fraction of a revolution can obviously be made by measuring the angle between the radii through the points on the blade under consideration and dividing this by 360 degrees (angular measurement of one revolution).

The numerical value of the fractional advance (obtained by dividing fractional pitch; i.e., "piece of

* Instructor, Lake Carriers' Association School of Marine Engineering, Cleveland, Ohio.



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pitch" by "whole pitch") is the same as the numerical value of the corresponding fractional revolution (obtained by dividing the arc of the circle; i.e., "piece of circumference," on the disk area upon which the two points are projected, by the "whole circumference" of this circle). These terms are schematically shown in Fig. 1.

The whole circumference can always be found, for it is easily computed for any distance from the center

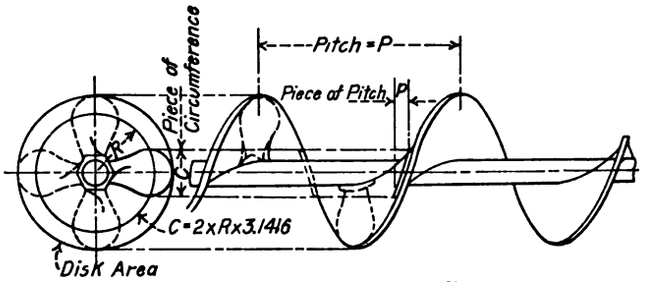


**Fig. 1.—Representation of propeller terms**

of the shaft to two points (between which the fractional pitch is to be measured) taken as the radius of a circle.

This relationship can be set down as a proportion or as an equation between two ratios, which is the equivalent, and, three quantities being known, the fourth may readily be found.

Thus referring to Fig. 1, where,

$P$ = Pitch of propeller
$p$ = Piece of pitch
$C$ = Whole circumference
$c$ = Piece of circumference

Then this relationship can be expressed by the following equations:

$$p : P = c : C$$

$$\frac{p}{P} = \frac{c}{C}$$

$$P \times c = p \times C$$

$$\text{or } P = \frac{p \times C}{c}$$

## Average Nominal Pitch

Inasmuch as practically all propeller blades have "radially-expanding pitch" and many also have "axially-expanding pitch," the average nominal pitch of a blade may be obtained by taking a number of measurements at different distances away from the center and between various points at the same distance from the center, the value of these measurements being averaged with respect to the areas involved in each case.

The operating engineer, however, is concerned chiefly in having all blades set alike; i.e., given the same inclination with respect to the shaft. By the aid of

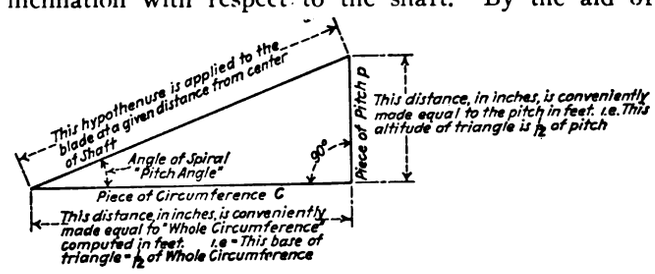
This hypothenuse is applied to the blade at a given distance from center of Shaft
Angle of Spiral "Pitch Angle"
90°
Piece of Pitch p
This distance, in inches, is conveniently made equal to the pitch in feet. i.e. This altitude of triangle is 1/12 of pitch
Piece of Circumference C
This distance in inches, is conveniently made equal to "Whole Circumference" computed in feet. i.e = This base of triangle = 1/12 of Whole Circumference

**Fig. 2.—Pitch board**

a "pitch board" applied to each blade at the same distance out from the center of the shaft, this inclination may be determined. This distance is usually 6 to 12 inches in from the tip and at the widest part of the blade. The measurement of the pitch at this point is generally accurate enough for all practical considerations.

A "pitch board," Fig. 2, may be made by measuring off, on the edge of any board, a distance in inches equal to the circumference of the circle mentioned, computed in feet, or 1/12 of the circumference of the circle. Use this as the base of a right triangle, the altitude of which is a distance in inches equal to the pitch in feet. Joining the remote ends of these distances gives the hypothenuse of the triangle which is applied to the blade at a measured distance from the center (widest part of blade).

The base must be parallel to the after face of the propeller hub when applied. In this case we may say, in 1/12 revolution we get 1/12 of the pitch advance.

When applying such a board to the blade of a propeller, the blade is twisted about its flange until straight-edges applied to the after face of the propeller hub are found to be equal distances away; i.e., the base of the pitch board is parallel to the after face of the hub.

When this has been done on all blades, then they are known to be set alike (as regards pitch) as they should be. Otherwise vibration results.

## Other Practical Methods of Measuring Pitch

Sometimes when the vessel is in drydock, rapid pitch determinations can be made by dropping a string with a weight on each end, over a blade in a horizontal position, at the desired distance from the center. The fore and aft distance between the strings (parallel to the shaft) would then give the "piece of the pitch," if the thickness of the blade edge be subtracted at the one end. The vertical distance between the lower and the higher edges of the blade measured along the one string will give the "piece of circumference". With these factors known the pitch can be computed.

Other practical methods, similar in character, of determining pitch by rotating the wheel and taking measurements to the stern post, or to the rudder post, and noting the fraction of revolution involved, need not be discussed in detail as any engineer should be resourceful enough to work them out himself if he understands the fundamental principles.

If the above discussion does not make the matter sufficiently clear, readers are cordially invited to send in a concise statement of their difficulties, mentioning the phases upon which further information is desired.

# Thermofan System of Heating and Ventilating

THE indirect system of heating and ventilating, known as the Thermofan system developed by the Schutte & Koerting Company, Philadelphia, Pa., has now been installed on a number of naval vessels, on about 20 of the ships of the merchant fleet and on several private yachts.

The Thermofan system consists of a ventilating fan, in the discharge duct of which are a heater and a humidifier. During the cycle of operations, as shown in Fig. 1, steam enters the heater through the steam supply valve, while the condensate is discharged through the exhaust valve and steam trap. Air is drawn through the fresh air inlet duct and is directed by the two-way damper to the heater. During its passage through the heater, the air is heated and humidified to the proper point (60 to 70 percent relative humidity for 60 to 65 degrees of Fahrenheit air) and then is discharged to the ventilating main and rooms, replacing the vitiated

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air which passes out through exhaust and other openings.

The two-way damper, in the position shown in Fig. 1, discharges all the air through the heater. As the damper is opened, air is passed without heating to the mixing chamber and ventilating duct. Thus, by adjusting the position of this damper, any desired temperature of the air in the distribution duct can be obtained. The current of air drawn across the tubes is continually divided or sliced into thin sheets or films, due to the close staggered arrangement of the tubes. The resistance to the passage of the air is almost negligible. The air

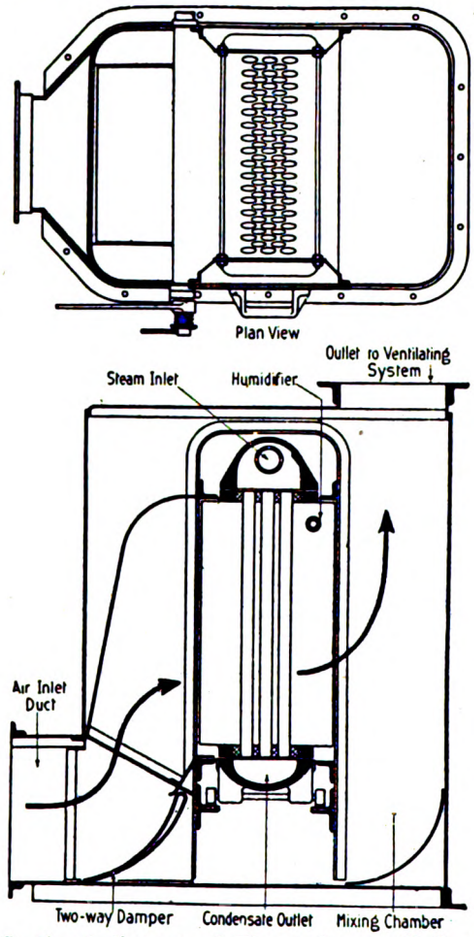


**Fig. 1—Sectional diagram of Thermofan ventilating system**

being thus brought into intimate contact with the tubes, a rapid and efficient absorption of heat is effected.

Straight tubes only are employed in this heating element and cover plates in the top and bottom heaters, which can be easily removed, contribute to the rapidity and readiness with which the heater may be cleaned of grease and oil carried over by exhaust steam. Any tube may be readily plugged, or replaced, and the heater inspected without disturbing the air ducts.

The advantage is claimed for the Thermofan system that the heating can be regulated closely. Positive and continuous circulation of the air is secured irrespective of weather conditions. Under the influence of the high air velocity the rate of heat transmission from a given amount of heated air pipe surface is a maximum.

Thermofans are designed in various sizes delivering from 1,000 to 10,000 cubic feet of air per minute.

### Cooling Thermofan

The same principles have been applied for cooling air, and the Thermofan for this purpose has found extensive application in the chambers of fruit-carrying ships, as well as in naval service in the magazine spaces. In this machine the cooling medium is dense air that is refrigerated and circulated through the cooling element which replaces the heating element previously described. Water of condensation is collected in a water separator and removed to a drain cock. The dense air inlet valve is controlled by a thermostat placed in the space to be cooled. When the temperature rises above a predetermined point, this valve opens and admits dense air to the cooler, closing as soon as the temperature is at the proper point.

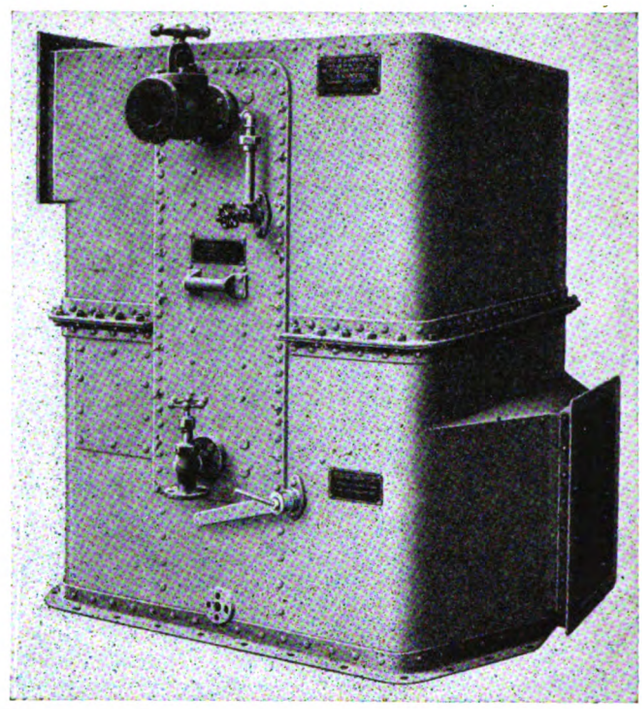

**Fig. 2.—Thermofan for heating, cooling and ventilating ships**

### Fire Extinguishing and Fumigating System

A third development of the Schütte & Koerting Company is a system of fire extinguishing and fumigation which utilizes boiler flue gases. The principle on which this system functions is that of reducing the oxygen content of the air by means of flue gases below that at which combustion will take place. This system consists of a washer for purifying the boiler flue gases, a blower for circulation and a simple arrangement of piping. The gases are drawn by the blower from the uptake of either the main boiler or the donkey boiler, passed through a washer where they are brought into contact with a series of cold water sprays, cooled, and soot and dust removed. Then the gases are forced through distribution pipes to the holds or bunkers. A valve is also provided for blowing air in large quantities into the hold in order to clear away the flue gases after a fire has been extinguished or the hold fumigated.

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TESTS ON PULVERIZED COAL BURNER.—The equipment, which has been perfected by engineers of the Todd Shipyards Corporation, 25 Broadway, New York city, providing a combination of a burner and pulverizer on ships burning pulverized coal, is being installed by the United States Shipping Board at the Philadelphia Navy Yard and will soon be ready for test. The tests will cover a period of several weeks duration.

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# Inter-Island Passenger Ship Waialeale

## General arrangement plans of hull and machinery—Details of passenger accommodations—Auxiliary machinery

GENERAL details of the twin-screw passenger vessel *Waialeale*, built for the Inter-Island Steam Navigation Company, Honolulu, T. H., at the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Cal., appeared on page 416 of the August issue of MARINE ENGINEERING AND SHIPPING AGE. This article was devoted principally to a description of the propulsion machinery which incorporates innovations in geared turbine drive. The present article will be devoted mainly to a description of the passenger accommodations on the vessel, the arrangement plans and details of the auxiliaries.

### Hull Design

The *Waialeale* is of the flush two-deck design with a two-deck steel superstructure. The hull is divided into seven compartments by six watertight bulkheads extending from the tank top to the main deck. These compartments from the bow aft are the forepeak tank, cargo hold No. 1, cargo hold No. 2, boiler room, engine room, cargo hold No. 3 and the afterpeak tank. The double bottom under the forward cargo holds and under the engine room is used for fuel oil storage, while fresh water is carried in the double bottom under the boiler room. The forward cargo holds are served by a large hatch and the 'tween deck space is arranged with ample head room so that automobiles can be stored. A large side port is also provided so that automobiles may be driven aboard.

The cargo handling equipment on the *Waialeale* includes five steam cargo winches, manufactured by Allan Cunningham of Seattle, Washington. The steering gear was supplied by the Hyde Windlass Company, Bath, Me. Brown type hydraulic telemotors are used in conjunction with this steering gear. A steam windlass for handling the anchors and chains was also supplied by the Hyde Company. The vessel is fitted with a Rich smoke detecting system, furnished by Walter Kidde & Company, New York city and a Derby fire alarm system. Two Warren 12-inch by 8½-inch by 12-inch, vertical duplex steam pumps supply pressure for fire mains located throughout the ship.

Navigating bridge is equipped with the latest instruments and safeguards for a ship of this type, including three Lietz standard compasses, one Lietz sounding machine, two Cory-Kent clear vision screens, Cory engine room telegraphs and anti-noise telephone, a Sperry revolution indicator, a Plant-Mills direction indicator and a Walker patent log.

### Accommodations

The captain's stateroom and office, as well as the deck officers' accommodations are located on the boat deck. Here also is the first-class smoking room which is finished in natural teak wood. A refreshment bar is included in the fittings for this room.

The passenger staterooms, all of which are on the promenade and shelter decks, have outside exposures. Most of these rooms will accommodate three passengers, each being furnished with two Simmons metal beds and a Simmons pullman berth. The fittings for each stateroom include a porcelain wash basin with running water, an electric fan and a thermos bottle. A dressing table and settee are included in the furnishings. A number of staterooms are fitted with private toilets and showers. Haskelite was used in finishing the stateroom bulkheads. The staterooms are painted with white enamel, which presents a pleasing appearance in contrast with the mahogany finish of the furniture and the dark carpets used for floor covering. The remaining public rooms include the social hall located forward on the promenade deck and the dining saloon on the main deck. The pantry, galley, engineering officers' and crew's quarters, mail room and cold storage are also located amidships on the main deck.

The social hall is finished in white enamel with mahogany trim, comfortably carpeted and furnished with wicker chairs and settees. A piano, Victrola and radio are also included in the equipment for the entertainment of passengers.

The dining saloon will seat 95 persons, mostly at individual tables for two or four, although there is one large center table seating eleven.

The floor in the dining saloon is laid with Goodyear rubber tiling. This tiling is also used on the stairways in combination with monel metal nose pieces.

Accommodations for the third-class passengers, including 44 women and 52 men, with lavatories and the like, are arranged aft on the main deck.

### Boilers and Auxiliary Equipment

The main propelling machinery described in the previous article consists of two 2000-shaft horsepower Westinghouse geared turbines. Steam is supplied by four Babcock & Wilcox marine watertube boilers, fitted with superimposed superheaters. These boilers, which have a total heating surface of 12,268 square feet, are designed for a working pressure of 280 pounds per square inch and a superheat of 75 degrees Fahrenheit. Babcock & Wilcox mechanical oil burners of the Cuyama design are fitted to each boiler. The boiler design incorporates a special double-furnace front construction to provide for either natural or assisted draft. Motor-driven blowers, built by the Western Blower Company, Seattle, Wash., are located at the rear of the boilers, the air being led through ducts under each boiler to the double-furnace front. The boilers are fitted with Diamond Power Specialty company marine type soot blowers.

The pumping and miscellaneous auxiliary equipment includes:

1 Warren vertical-duplex fuel oil transfer pump, 10 inches by 7 inches by 12 inches
1 Warren vertical-duplex fuel oil service pump, 5¼ inches by 4 inches by 4 inches by 8 inches
1 Quimby screw-type fuel oil service pump, capacity 15 gallons per minute against 200 pounds per square inch pressure
2 Warren vertical-simplex feedwater pumps, 12 inches by 9 inches by 24 inches
1 Davis Paracoil closed-type feedwater heater, capacity 55,000 pounds of water per hour from 83 to 230 degrees Fahrenheit
1 Hickman air separator, capacity 55,000 pounds of feedwater an hour
1 Davis Paracoil evaporator



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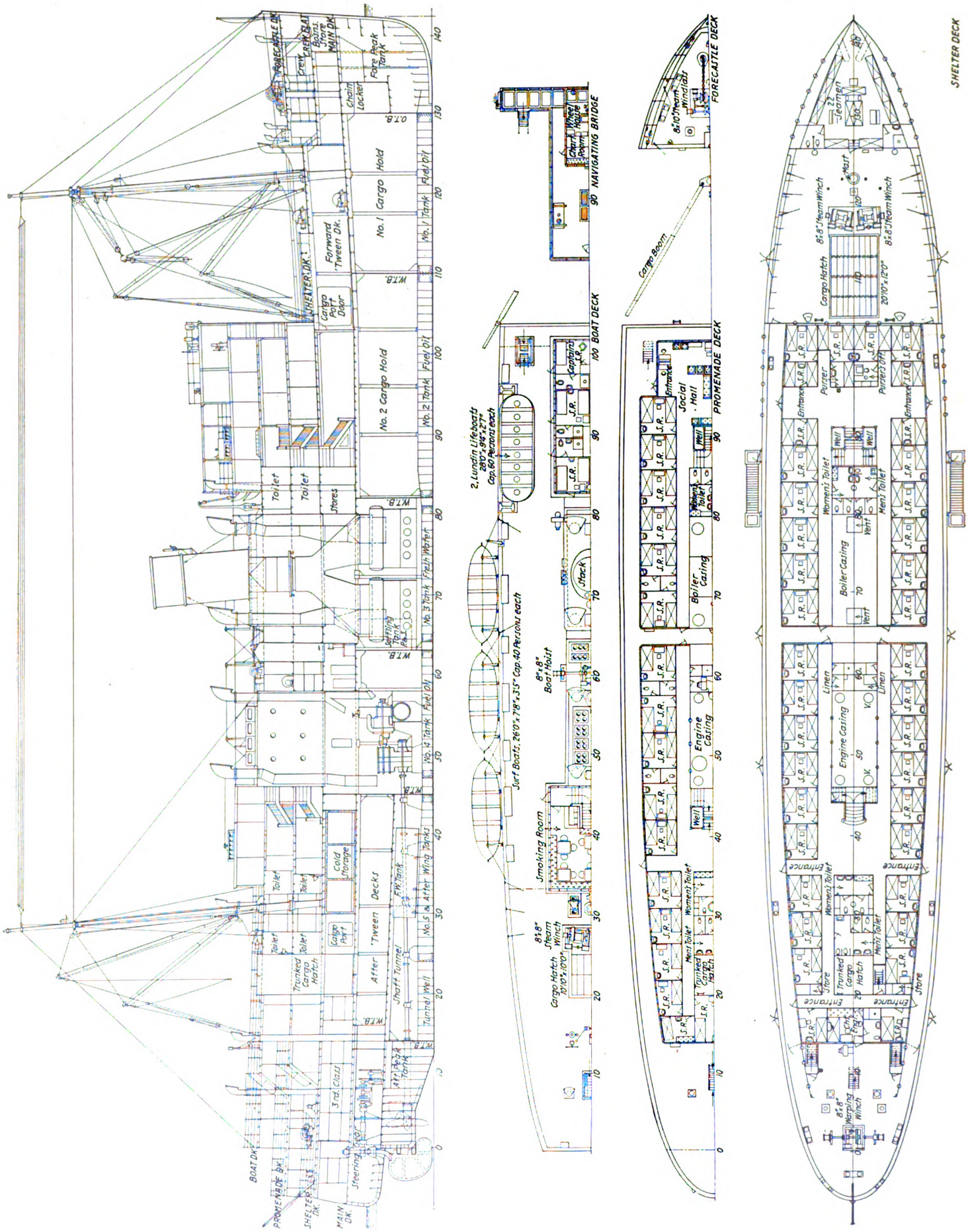


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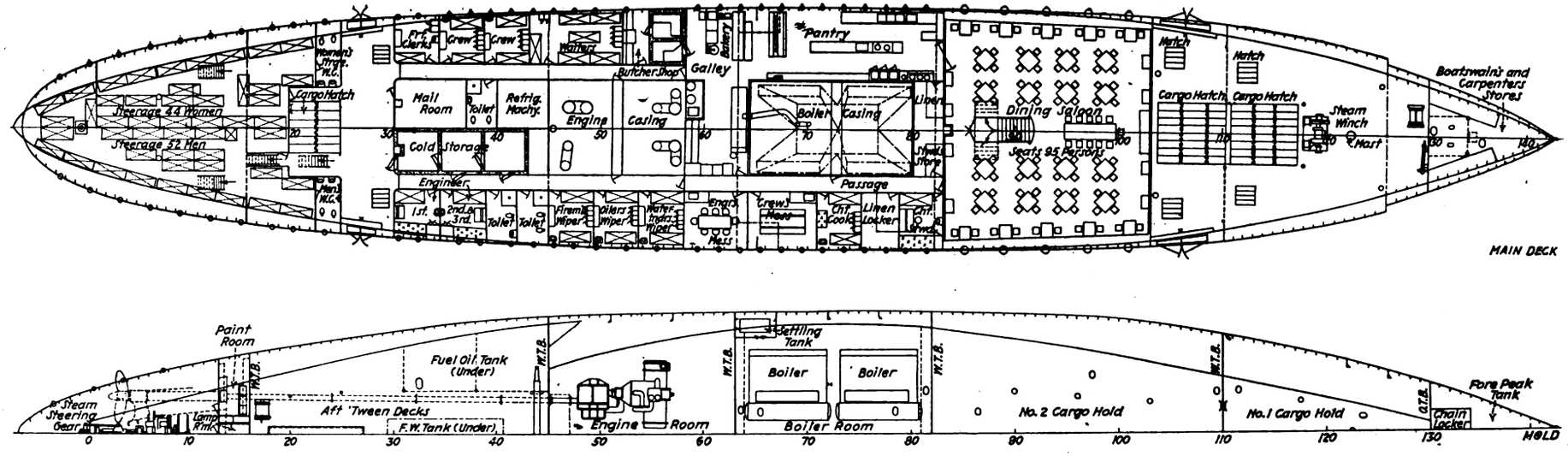
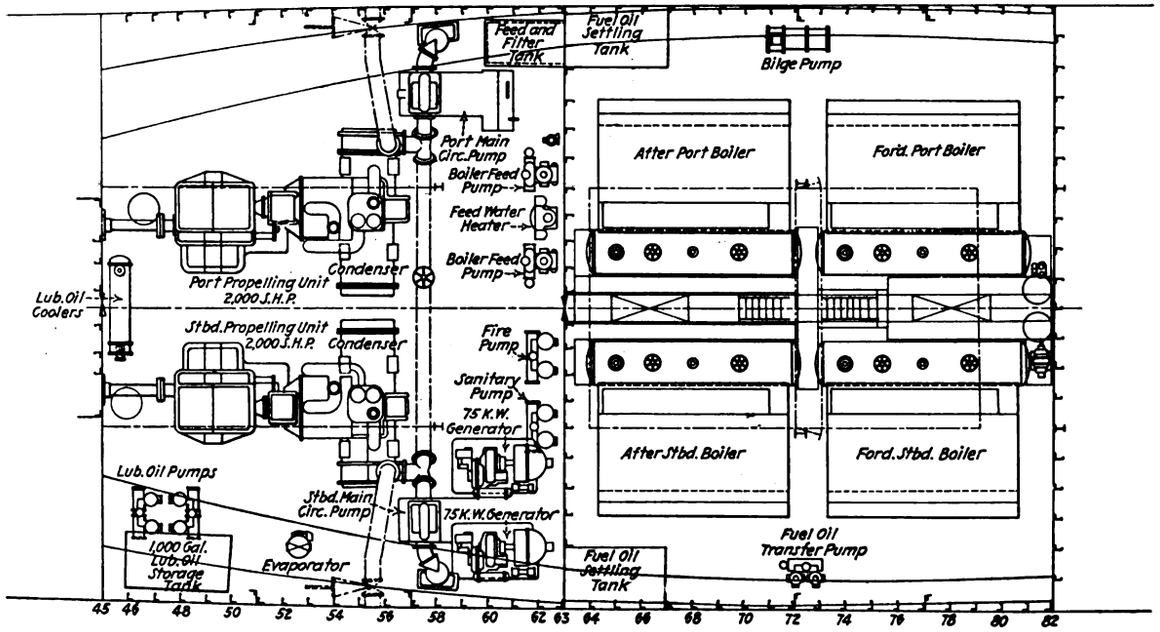
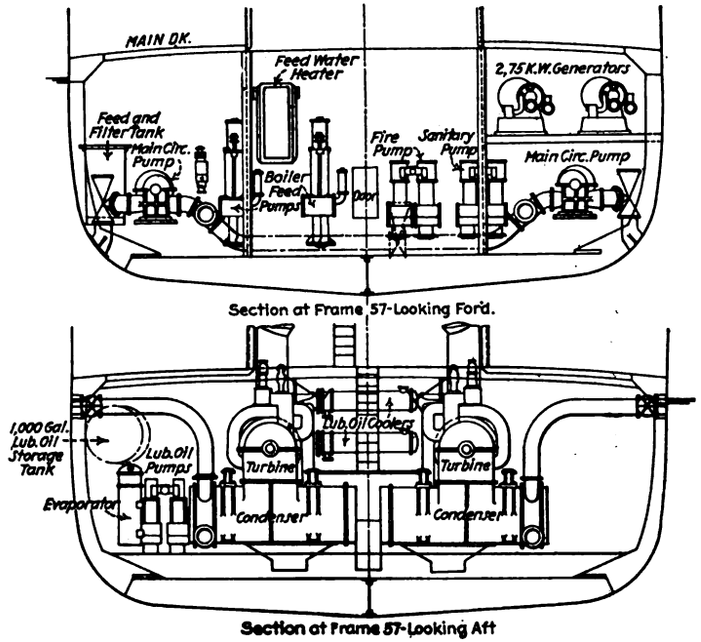



**Inboard profile, deck and hold plans of S. S. Waialeale**




**Machinery arrangement of the S. S. Waialeale**

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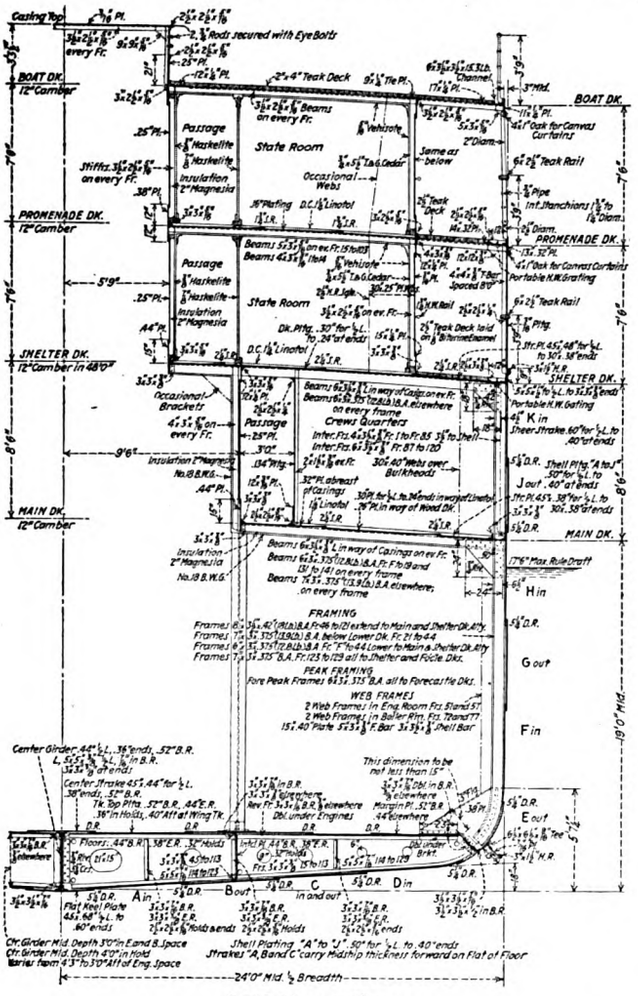
1 Davis Paracoil distiller
2 Davis Paracoil lubricating oil coolers
1 De Laval centrifugal oil separator

### Ventilating Equipment

The ventilating system on the *Waialeale* is of considerable importance because of the necessity of maintaining an abundance of cool fresh air for the comfort of the passengers. Great care was taken in designing the *Waialeale* to provide a maximum amount of natural ventilation. In addition, every compartment of the vessel, including passenger spaces, storerooms, holds, galley, pantry, machinery spaces, boiler rooms and the shaft alley have been provided with modern and effi-




cient mechanical exhaust and supply ventilation. For this purpose, Ilg electrically-driven, direct-connected blowers supplied by the Western Engineering Company, San Francisco, Cal., are used. Operating as a supply system, these blowers ventilate the main dining saloon, galley and steerage quarters. The passages and toilets forward and the passages and toilets aft are served by blowers operating in the exhaust system. Each stateroom is fitted with a Westinghouse marine type fan. Two Vulcan refrigerating units supply cold storage for stewards' stores, as well as for the 30 tons of refrigerated cargo which can be carried.

Throughout the design and equipment of this vessel great care has been exercised to fit her for the service in which she will operate. This service is practically an extension of that provided to Hawaii by the liner *Malolo* and as such the highest class of accommodations is required.

# New York State Hydraulic Dredge No. 4

THE State of New York hydraulic dredge *No. 4*, which was designed by the engineers of the Department of Canals and Waterways and built at the Syracuse shops of the department, has recently gone into commission. The work of construction was conducted under the supervision of Major T. F. Farrell,

**State of New York hydraulic dredge No. 4**

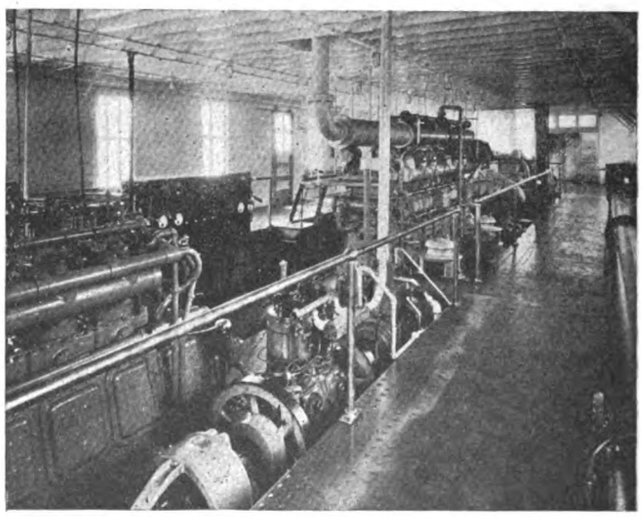
commissioner of Canals and Waterways; William M. Acheson, chief engineer and Guy W. Pinck, district engineer, the latter being in direct charge.

The hull is 106 feet long, with a beam of 28 feet and a depth of 8 feet. With the exception of two hoist winches and a cutter motor, all machinery is mounted in a well 66 feet long, 15 feet wide and 3 feet 1 inch deep.

For hydraulic dredging purposes a 15-inch Morris centrifugal pump is installed. This pump is capable of delivering 200 cubic yards of material per hour against a 40-foot head and handles up to 25 percent solids. The pump is driven by a six-cylinder, four-stroke cycle Diesel engine, manufactured by the Bessemer Engine Company, Grove City, Pa. This engine develops 500 brake horsepower at 275 revolutions per minute and is direct connected to the pump through a Francke floating-ring type coupling.

A main auxiliary generator unit consisting of a Bessemer, four-cylinder, Diesel engine direct connected to a 100-kilowatt, 250-volt direct-current generator, manufactured by the General Electric Company, Schenectady, N. Y., is also installed. This unit supplies all the current for lights and auxiliary machinery on board.

A two-cylinder Diesel engine built by the Hill Diesel Engine Company, Lansing, Mich., direct connected through clutches to an 8-kilowatt, 250-volt generator



**View in engine room of New York state dredge**

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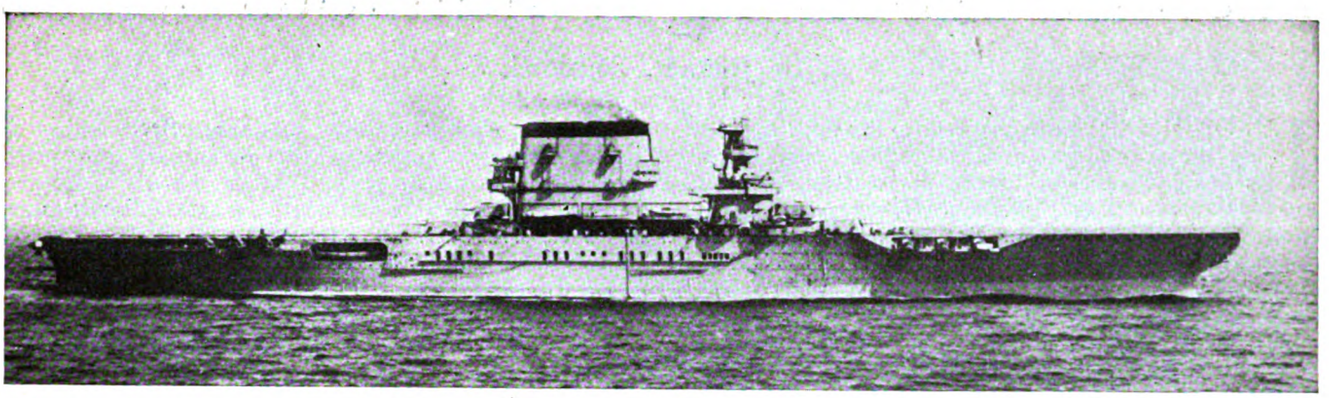


**Airplane carrier U. S. S. Saratoga under way**

serves as an emergency unit. This engine also operates a 5½-inch by 2¾-inch by 5-inch two-stage air compressor and a 4-inch Gould centrifugal pump.

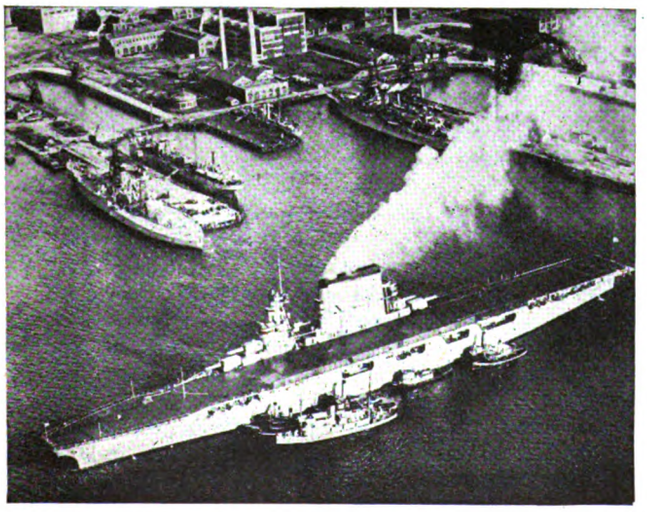
The remaining auxiliary machinery includes:

Two four-inch Morris vertical centrifugal pumps driven by 30-horsepower motors
One dredging pump priming ejector, manufactured by Schutte & Koerting
One 250-pound per square inch, two-stage starting air compressor
Two 10-gallon-per-minute Viking fuel transfer pumps
One lubricating oil centrifuge, manufactured by the DeLaval Separator Company, New York city
Reed air filters
Brown exhaust pyrometers

# Airplane Carriers Saratoga and Lexington Prove Efficiency In Service

SINCE joining the Pacific battle fleet, the most recent acquisitions to the forces of the United States Navy, the airplane carriers *Saratoga* and *Lexington* have demonstrated their efficiency as the most mobile ships of the service. Combining the speed of the fastest scout cruisers and heavier armament than the cruisers carry with their complement of scout, bombing and combat planes, these ships constitute the most formidable fighting craft in the world.

In a recent trial run in Pacific waters, over a measured mile course, the U. S. S. *Saratoga,* shown in the illustrations, attained a speed of 33.42 knots, establishing a world's record for capital ships. On a speed run from San Pedro, Cal., to Honolulu, Hawaiian Islands, the U. S. S. *Lexington* for three successive days broke the 24-hour steaming record and also established a new mark for the trip from the United States, by making the distance of 2228 nautical miles in 72 hours, 34 minutes. The average speed for the entire run was approximately 30.7 knots.



**Airplane view of U. S. S. Saratoga**

The electrical propelling machinery on each vessel, which was built by the General Electric Company, is similar in type and consists of four 35,000-kilowatt turbine-generator units supplying current to eight 22,500-horsepower propelling motors. Steam is supplied by 16 Yarrow-type watertube boilers, equipped to burn oil.

The armament which is primarily intended to repel air attacks includes five 5-inch anti-aircraft guns and eight 8-inch rifles in barbette mounts.

# Diesel Cruiser Margo II

THE *Margo II,* a twin-screw Diesel engine driven cruiser is one of the recent additions to the fleet of fine pleasure craft on the Great Lakes. She was designed by Henry C. Grebe & Company, Inc., Chicago, Ill., for B. A. Massee of that city, and was built at the yards of the Great Lakes Boat Building Corporation, Chicago, Ill. She has a length overall of 98 feet, beam of 17 feet and 6 inches and draft of 6 feet. The main power plant consists of a pair of lightweight, high-speed Diesel engines built by the Winton Engine Company, Cleveland, O. Each engine develops 200 horsepower and drives a 36-in. diameter, 28-inch pitch, three-bladed propeller. The cruiser has a speed of 15½ knots.

The auxiliary equipment includes a Winton two-stage, water-cooled, air compressor for starting and maneuvering. This machine, which is driven by a 5-horsepower electric motor, provides 400 pounds pressure at 600 revolutions per minute.

CURRENT AMERICAN SHIPBUILDING—On August 1, American shipyards were building or under contract to build for private shipowners 377 steel vessels of 213,817 gross tons compared with 396 steel vessels of 225,740 gross tons on July 1, according to the Bureau of Navigation, Department of Commerce.

There were 78 wood vessels of 42,557 gross tons building or under contract to build for private shipowners during the same period compared with 87 wood vessels of 38,670 gross tons on July 1.

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# Method of Solving Continuous Beams

By John P. Comstock

IN ORDINARY merchant-ship design, in selecting the scantlings for a ship's steel structure, it is usually sufficient to use the classification societies' "rule scantlings," without further consideration of the matter of strength. But frequently cases arise when special strength calculations must be made. In these cases it is not unusual to find "continuous beams." It must, of course, be borne in mind that continuous-beam stresses can be used only when the essential assumption of unyielding supports is either true or very nearly true.

It is evident that should a support be depressed by the load of the beam, the negative bending moment over the support would be decreased, and the positive bending moments under the loads in the adjacent spans would be increased; in short, the continuous beam formulae would become worthless. In land structures, practically unyielding supports can readily be obtained, but in a ship this condition is more unusual. But cases do arise when supports are nearly enough unyielding, or a number of them, although yielding, yield so nearly the same amount, that the beam they carry is stressed very nearly as a continuous beam. In such cases the stresses obtained by considering the beam continuous, either used directly or modified slightly in the direction of simple-beam conditions, are much nearer the actual conditions than simple-beam stresses would be, and it would be wasteful to design it as a simple beam between supports, and dangerous to neglect the bending moment at the supports. Yielding of supports will be mentioned again later.

But when confronted with a continuous beam, the designer finds two lines of attack, both unsatisfactory. On the one hand he has sets of special cases in handbooks, which, nine times out of ten, will not fit the case in hand. On the other hand he has Clapeyron's "theorem of three moments," which gives him a somewhat complicated set of equations so completely devoid of physical meaning to the ordinary mind that, unless they are being used continually, the method is completely forgotten between jobs, and must be studied out anew for each case. The methods using Maxwell's theorem and influence lines, and using Castigliano's theorem, while easier for trying a large variety of loadings on a given beam, are no better than the three-moment theorem for a given beam with a single given loading.

The method about to be described, while containing no new theory, has the real advantage, in addition to that of being quick, of being physically obvious, and so can be used at long intervals with a minimum of study. The basis of this method is the condition that there is no deflection at the points of support. This is of course the basis of the three-moment theorem also. The three-moment theorem gives the bending moments at the supports, and, knowing these, the reactions at the supports can be calculated. The method here described gives the reactions directly, and knowing them, the bending moment at any point can be calculated.

Suppose a beam, continuous over a number ($n$) of spans, carries a number of concentrated loads. Now suppose that all the supports, except those at the ends, are removed. The beam will sag. Now let us apply upward loads at what were the intermediate points of support, of such magnitude that the deflections at the points of support produced by the combined downward and upward loads are exactly zero. Then the upward loads must be precisely what the reactions at the supports were in the first place. Hence the beam could be solved by the following steps:

1. Consider the beam as a simple beam, supported at the ends only.
2. Consider the reactions, except the end reactions, as unknown upward loads.
3. Obtain the equation for the deflection at each support, due to the combined known downward loads and unknown upward loads, and place these deflections equal to zero. This gives ($n$-1) linear or first-degree equations, involving ($n$-1) reactions, which, when solved, simultaneously give all but the end reactions.
4. Taking moments about either end will give the reaction at the other end.
5. With all loads and reactions known, the bending moment at any point can be obtained as the moment about that point of all of the forces to either side of it.

It would appear that this method is just as laborious as the three-moment theorem, and, indeed, it would be, were it not for the fact that the larger part of the work can be done once for all and plotted into a chart. In the first place, all of the deflection equations will contain $L^3/EI$ in every term, and so these factors can be dropped out. In other words, the relation of reactions to loads is independent of the length of the beam, the moment of inertia of its cross-section, and its modulus of elasticity. In the second place, by using a unit-length beam, and a unit load at any given point in it, a curve of deflections can be calculated and plotted, and the ordinate to this curve at any point, multiplied by any load $P$, will be proportionate to the deflection at that point, in a unit-length beam, resulting from the load $P$ applied at the point for which this curve was drawn. As has been shown, this is all we need to use in our deflection equations. (This same ordinate, multiplied by $PL^3/EI$, would give the actual deflection, were it desired.) Further, a whole set of such deflection curves can be calculated and plotted, showing the deflection factors for varying positions of $P$ all across the beam. In practice, of course, only half the beam need be covered, for the other half would be the same, to the opposite hand. This brings us to Fig. 1, which is such a chart for a simple beam.

It will now be evident that in order to write the equations in step No. 3 above, for the deflection at any particular point of support, it is necessary only to express the distances of the loads and reactions from the ends of the beam as percentages of the over-all length, read from Fig. 1 the deflection factors for the deflections caused at this support by the various loads and reactions, multiply these factors by their respective loads or reactions, and place the algebraic sum equal to zero. This is done for each of the interior supports, resulting in the required ($n$-1) equations. The whole problem is thus reduced to comparatively simple algebra—the solution of simultaneous first-degree equations.

It will be apparent that a cantilever beam, built-in at one end, continuous over several supports, and freely loaded or supported at the other end, can be solved by



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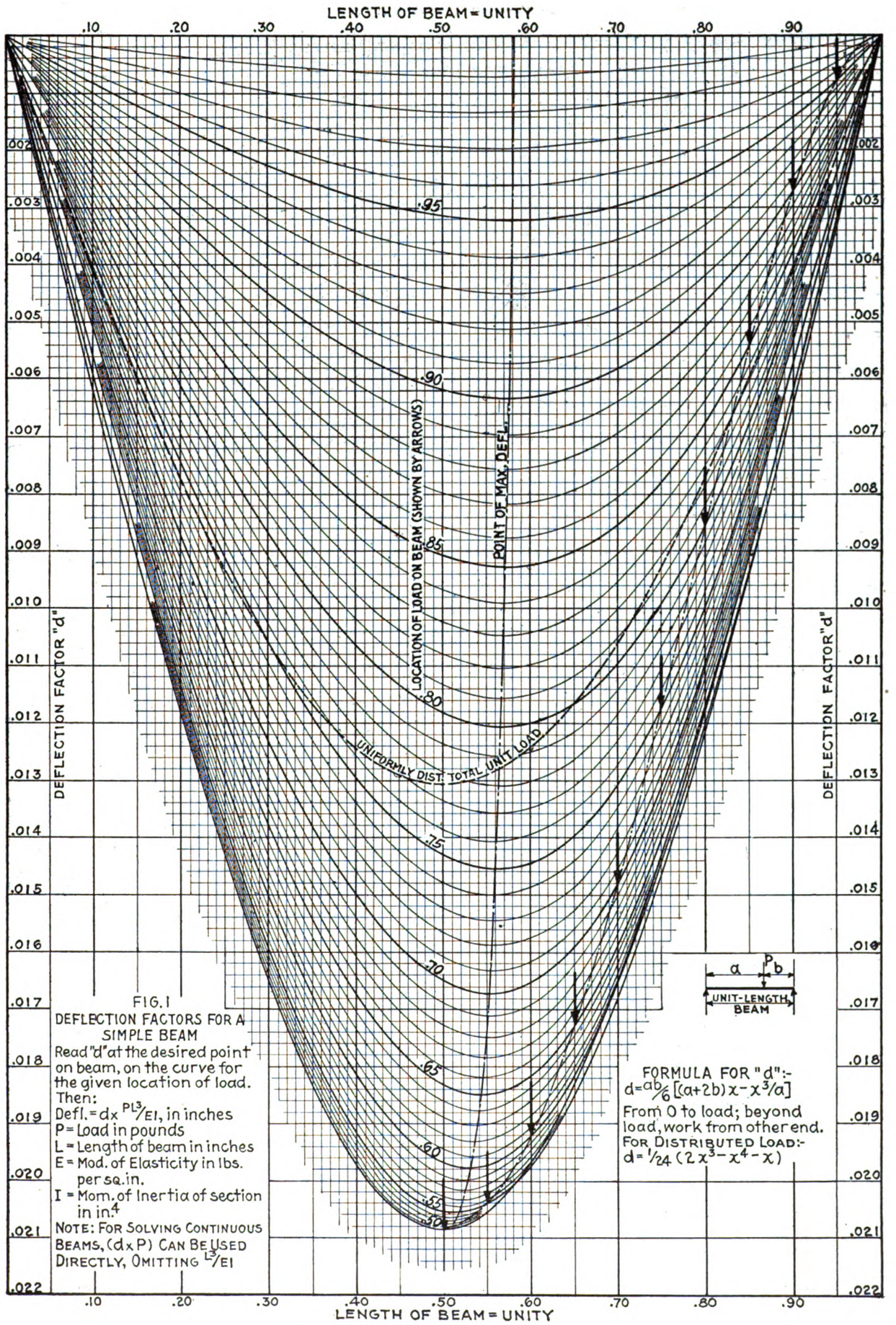
LENGTH OF BEAM = UNITY
.10 .20 .30 .40 .50 .60 .70 .80 .90
DEFLECTION FACTOR "d"
.002 .003 .004 .005 .006 .007 .008 .009 .010 .011 .012 .013 .014 .015 .016 .017 .018 .019 .020 .021 .022
.95
.90
.85
.80
.75
.70
.65
.60
.55
.50
POINT OF MAX. DEFL.
LOCATION OF LOAD ON BEAM (SHOWN BY ARROWS)
UNIFORMLY DIST. TOTAL UNIT LOAD
a
b
UNIT-LENGTH BEAM
FIG. 1
DEFLECTION FACTORS FOR A SIMPLE BEAM
Read "d" at the desired point on beam, on the curve for the given location of load. Then:
Defl. = d x PL³/EI, in inches
P = Load in pounds
L = Length of beam in inches
E = Mod. of Elasticity in lbs. per sq. in.
I = Mom. of Inertia of section in in.⁴
NOTE: FOR SOLVING CONTINUOUS BEAMS, (d x P) CAN BE USED DIRECTLY, OMITTING L³/EI
FORMULA FOR "d":-
d = ab/6 [(a+2b)x - x³/a]
From 0 to load; beyond load, work from other end.
FOR DISTRIBUTED LOAD:-
d = 1/24 (2x³ - x⁴ - x)

**Fig. 1.—Deflection factors for a simple beam**

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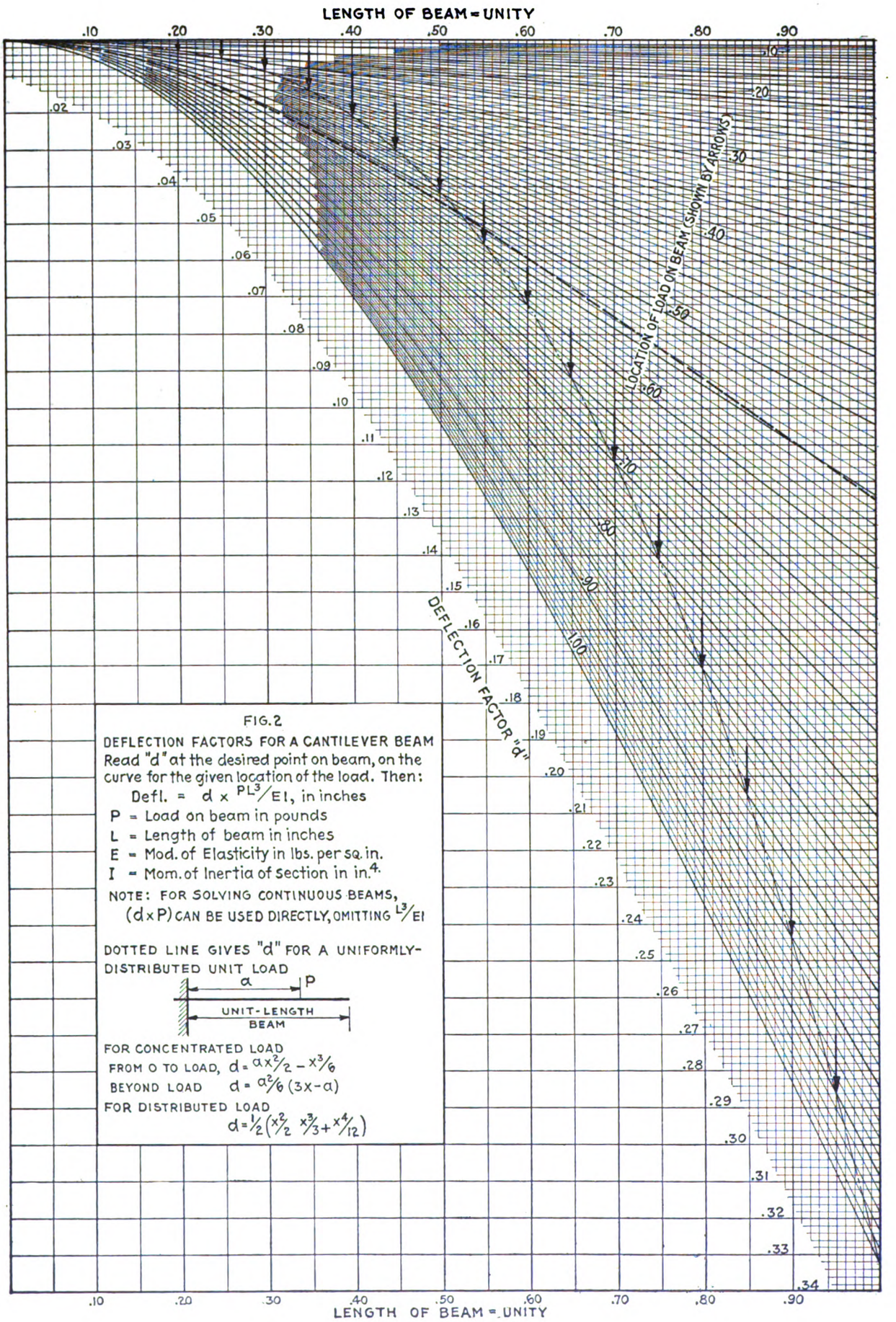
LENGTH OF BEAM = UNITY
.10 .20 .30 .40 .50 .60 .70 .80 .90
LOCATION OF LOAD ON BEAM (SHOWN BY ARROWS)
.10 .20 .30 .40 .50 .60 .70 .80 .90 1.00
DEFLECTION FACTOR "d"
.02 .03 .04 .05 .06 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30 .31 .32 .33 .34
FIG. 2
DEFLECTION FACTORS FOR A CANTILEVER BEAM
Read "d" at the desired point on beam, on the curve for the given location of the load. Then:
Defl. = d x PL³/EI, in inches
P = Load on beam in pounds
L = Length of beam in inches
E = Mod. of Elasticity in lbs. per sq. in.
I = Mom. of Inertia of section in in.⁴
NOTE: FOR SOLVING CONTINUOUS BEAMS, (d x P) CAN BE USED DIRECTLY, OMITTING L³/EI
DOTTED LINE GIVES "d" FOR A UNIFORMLY-DISTRIBUTED UNIT LOAD
a
P
UNIT-LENGTH BEAM
FOR CONCENTRATED LOAD
FROM O TO LOAD, d = ax²/2 − x³/6
BEYOND LOAD d = a²/6 (3x − a)
FOR DISTRIBUTED LOAD
d = ½(x²/2 x³/3 + x⁴/12)
LENGTH OF BEAM = UNITY

**Fig. 2.—Deflection factors for a cantilever beam**

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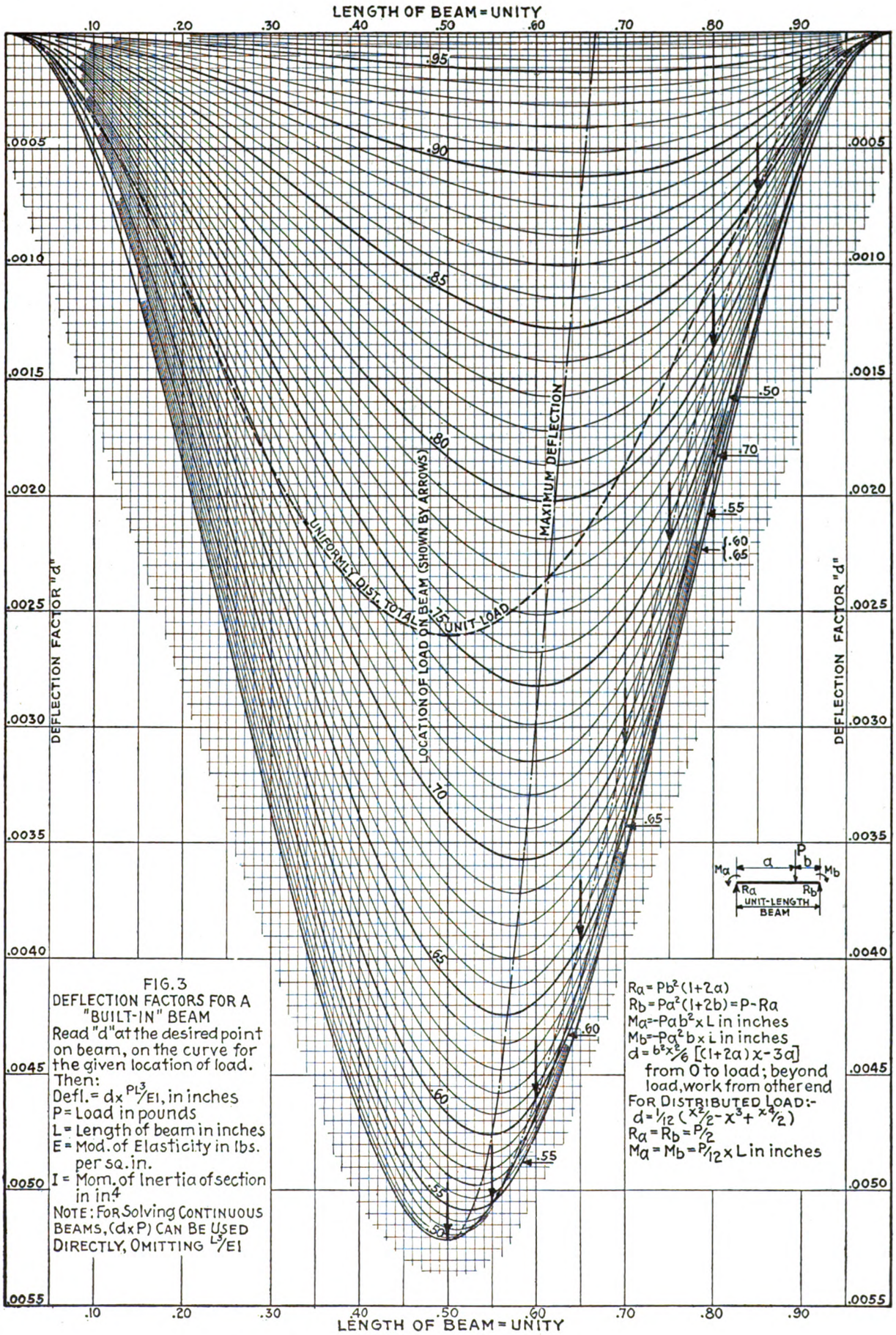
LENGTH OF BEAM = UNITY
.10 .20 .30 .40 .50 .60 .70 .80 .90
DEFLECTION FACTOR "d"
.0005 .0010 .0015 .0020 .0025 .0030 .0035 .0040 .0045 .0050 .0055
LOCATION OF LOAD ON BEAM (SHOWN BY ARROWS)
.95 .90 .85 .80 .75 .70 .65 .60 .55 .50
MAXIMUM DEFLECTION
UNIFORMLY DIST. TOTAL = 1 UNIT LOAD
FIG. 3
DEFLECTION FACTORS FOR A "BUILT-IN" BEAM
Read "d" at the desired point on beam, on the curve for the given location of load. Then:
Defl. = d x Pl³/EI, in inches
P = Load in pounds
L = Length of beam in inches
E = Mod. of Elasticity in lbs. per sq. in.
I = Mom. of Inertia of section in in⁴
NOTE: FOR SOLVING CONTINUOUS BEAMS, (d x P) CAN BE USED DIRECTLY, OMITTING L³/EI
Ra = Pb²(1+2a)
Rb = Pa²(1+2b) = P - Ra
Ma = -Pab² x L in inches
Mb = -Pa²b x L in inches
d = b²x²/6 [(1+2a)x - 3a] from 0 to load; beyond load, work from other end
FOR DISTRIBUTED LOAD:-
d = 1/12 (x²/2 - x³ + x⁴/2)
Ra = Rb = P/2
Ma = Mb = P/12 x L in inches
P
a
b
Ma
Mb
Ra
Rb
UNIT-LENGTH BEAM

**Fig. 3.—Deflection factors for a "built-in" beam**

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precisely an analogous method, and a similarly-constructed chart of deflection-factors for cantilever beams is presented as Fig. 2, without further discussion.

To complete the subject, a third and similar chart, showing deflection-factors for a beam built in at both ends, is given in Fig. 3. In this case, however, after finding all of the intermediate reactions in the same way as in the case of the simple beam, it will not be possible to determine the end reactions by simple moments about either end, because there is a bending moment at each end of the beam. The amount of the end reactions, and of the end bending moment, due to each of the loads and interior reactions, is given by the equations on the chart, and these must be added together to give the total end reaction or moment. Knowing these, the bending moments at other points can be obtained by ordinary summation of moments.

In any of these three charts, the deflection curve for a uniformly-distributed unit load can be calculated, plotted and used in just the same way as the concentrated-load curves, either alone or with the latter, and this curve appears in each of the charts.

These three charts, alone or in conjunction with each other, cover all possible cases of continuous beams with concentrated loads, or loads uniformly distributed throughout the beam. For instance, a beam with several built-in supports can be solved by using Fig. 3 for the portions between the built-in supports, considering any intermediate free supports as upward loads, and using Fig. 2 for the overhanging ends, if any. However, Fig. 1, alone, will most frequently be used.

In the opening paragraph, the importance of the assumption of unyielding supports, essential to the ordinary treatment of continuous beams, was emphasized. In using these charts, however, the effect of any assumed relative settlement of any support on the stresses in the beam can readily be found. For when the deflections at any particular support have been expressed as above, it is just as easy to place their algebraic sum equal to any assumed deflection as to place it equal to zero, and the resulting reactions and bending moments will be the reactions and bending moments, if that support should settle the assumed amount. This may occasionally be useful.

Two examples, using Figs. 1 and 3, will be sufficient.

In Fig. 4 a beam is shown, continuous over three spans, unrestrained, carrying a distributed load and

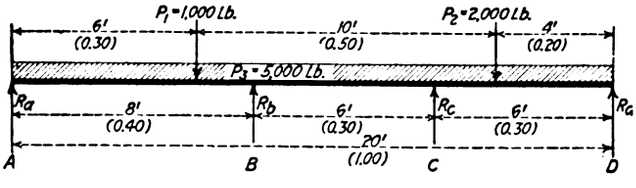


Fig. 4

two concentrated loads. The spacing of the loads and supports is expressed both in feet and decimally in terms of the total length.

Using Fig 1, the deflection at $B$ is as follows:

Due to $P_1$: (B is 0.60 from the right end, $P_1$ is 0.70), = 0.0165 × 1000.
Due to $P_2$: (B is 0.40 from the left end, $P_2$ is 0.80), = 0.0107 × 2000.
Due to $P_3$: = 0.0124 × 5000.
Due to $R_b$: = 0.0192 × $R_b$.
Due to $R_c$: = 0.0150 × $R_c$.
Adding: 0.0192 $R_b$ + 0.0150 $R_c$ = 99.7

Similarly, the deflection at $C$ is:

Due to $P_1$: 0.0123 × 1000.
Due to $P_2$: 0.0110 × 2000.
Due to $P_3$: 0.0106 × 5000.
Due to $R_b$: 0.0150 × $R_b$.
Due to $R_c$: 0.0148 × $R_c$.
Adding: 0.0150 $R_b$ + 0.0148 $R_c$ = 87.3
Combining these two equations to eliminate $R_b$:
0.0031 $R_c$ = 9.4, or $R_c$ = 3030 pounds
and $R_b$ = 2830 pounds
Taking moments about $D$:
$R_a$ = (1000 × 0.7) — (2000 × 0.2) — (5000 × 0.5) — (3030 × 0.3) = (2830 × 0.6)
$R_a$ = 993 pounds
Similarly, taking moments about A, $R_d$ = 1147 pounds.

Having found all the reactions, it is a simple matter to find the bending moment at any desired point; it is unnecessary to go through that here.

If this beam is worked out through the three-moment theorem, the reactions come out 3100, 2790, 996, and 1114 pounds respectively, instead of the above values. The errors involved are two: that in constructing the chart, and that in reading from it. If the uncertainties brought out in the opening paragraph are remembered, it will be seen that the errors are well within the accuracy justified by the nature of the problem.

A built-in beam with a single intermediate support (Fig. 5) will be solved to illustrate obtaining the end

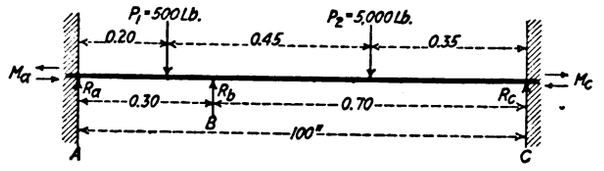


Fig. 5

reactions and moments of a built-in beam. The deflection at $B$ is:

Due to $P_1$ (at 0.70, due to load at 0.80) = 0.0109 × 500.
Due to $P_2$ (at 0.30, due to load at 0.65) = 0.0138 × 5000.
Due to $R_b$ (at 0.70, due to load at 0.70) = 0.0148 × $R_b$.
Therefore, 0.0148 × $R_b$ = (0.0109 × 500) + (0.0138 × 5000)
And $R_b$ = 5030 pounds.

Using the formula for end reaction in Fig. 3:

$R_a$ = [500 × (0.80)² (1.40) ] + [5000 × (0.35)² (2.30) ] — [5030 × (0.70)² (1.60)]
= —2082 pounds (notice that it comes out a downward reaction).
Similarly, $R_c$ = 2552 pounds (upward).
Bending moment at $A$: — 500 × 0.20 × (0.80)² × 100
—5000 × 0.65 × (0.35)² × 100
+5030 × 0.30 × (0.70)² × 100
B.M. = +27,800 inch-pounds (positive moment, beam concave upwards).
Similarly, $R_c$ = 2552 pounds (upward).
beam concave downwards).

The maximum bending moment will be found to occur under $P_2$, and is, using moments to the right of $P_2$:
—43,900 + (2552 × 35) = +45,400 inch-pounds.

To check, use moments to the left of $P_2$:
27,800 + (5030 × 0.35) — (2082 × 65) — (500 × 45) = +45,800 inch-pounds.

The small discrepancy results from, and indicates the magnitude of, the error in the interior reaction $R_b$, as discussed at the end of the first example.

With these two examples, it is believed that the manner of using these charts to obtain first the intermediate reactions, then the end reactions and finally any desired bending moment will be clear.

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ELECTRIC BATTLESHIP AWARDED TROPHY. — The award of the battle-efficiency pennant of the United States Navy this year to the U.S.S. *New Mexico* makes the seventh award to an electrically-propelled ship during the last eight years. The pennant was held by the U. S. S. *Pennsylvania* in 1922-1923.

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# Efficiency and Economy in the Steward Departments on Passenger Vessels

## Suggestions for improving the arrangement of galleys, pantries and dining rooms on transoceanic vessels

By L. Schumacher*

AMONG practical stewards there is a strong belief that in the design of many of the transoceanic vessels on which passenger transportation is the main factor in monetary value, or at least as important as cargo and mail, first consideration was given to the arrangement of cargo holds and hatches, and the installation of machinery, while the remaining space was considered good enough to serve as the steward's department. The fact that some responsible persons were unaware of certain impracticabilities has often resulted in much waste of space, improper arrangement of fixtures and other inconveniences, all of which are contrary to economy and efficiency. If naval architects and engineers knew of the existing shortcomings, improvements would be made.

In view of the fact that the steward's department on passenger vessels includes the largest and most expensive part of the crew, it is remarkable that more thought has not been given to the design of this part of the ship before beginning construction. It is a fact, however, that when it comes to the matter of determining practical locations for kitchens, pantries, messes, dining rooms and storerooms, and the arrangement of fixtures in them, consultation with able stewards and chefs is frequently neglected.

Naval architects and engineers realize that the number and type of passengers to be carried are the main factors which influence the design of passenger accommodations. But this is not all. Consideration should be given to the size of the ship, which influences the location and kind of space provided for storing, cooking and serving food. Consideration should also be given to the route on which the vessel is employed and, not the least important, to the number of dishes to be cooked and served, and the kind of service given.

For instance, the amidships galley and pantry on a vessel of 10,000 gross tons, or smaller, might have a quite different location than those on a ship of larger size and much increased passenger-carrying capacity could ever have. On smaller vessels the kitchen and pantry locations might take in only half the width of the ship, or thereabouts, while, for obvious reasons, this system would never be practical on larger vessels. On ships intended for tropical voyages, the ventilators, refrigerators and various fixtures are of importance. The floor space, the size of ranges, the dishwashing department, etc., depend not only upon the number and type of passengers, but to a large extent upon the number of dishes to be cooked and served during a meal, and the kind of service given. The varying styles of *à la carte* services need perhaps double the floor space, and proportionally larger fixtures, than a *table-d'hôte* service for the same number of passengers.

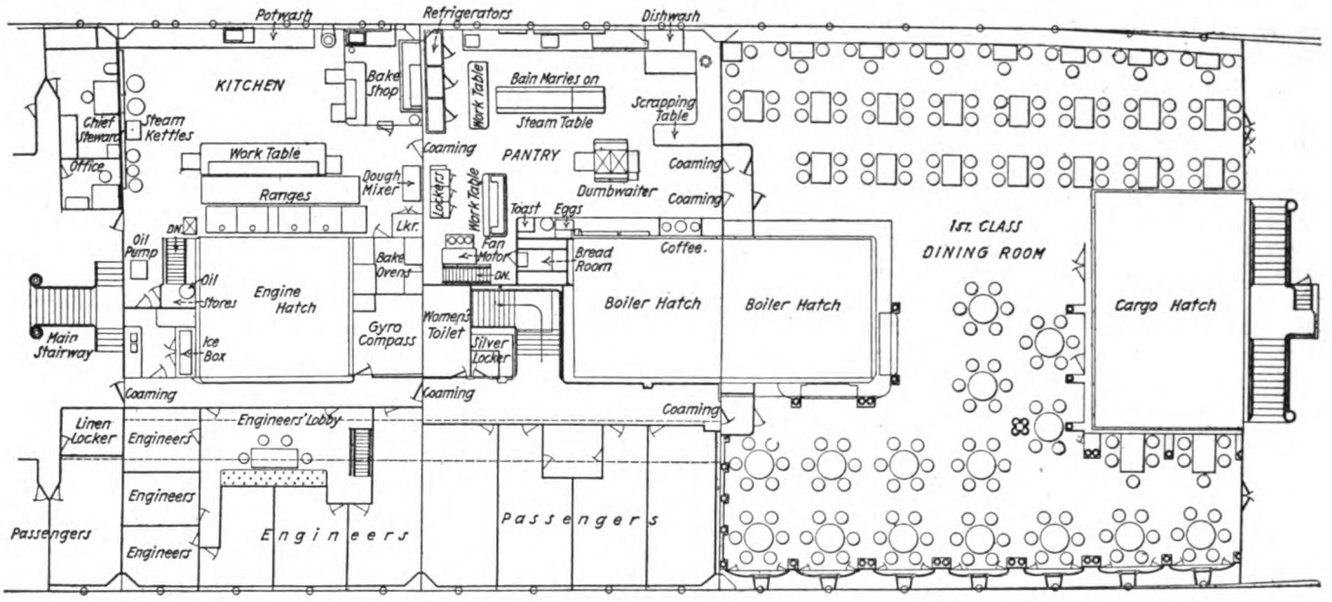


**Fig. 1.—Arrangement of kitchen, pantry and dining room on a number of vessels of 12,000 tons gross**

The location and kind of space provided for kitchens and pantries often cause a number of shortcomings in the way of impractical, inefficient and uneconomical fixture arrangements and waste of space.

To make this clearer, attention is invited to Fig. 1, which shows the arrangement of the kitchen, pantry and dining room on a number of vessels of 12,000 gross tons. In this plan will be found an exceptionally large number of impractical fixture arrangements, as well as waste of space, all of which are directly trace-

* Commissary controller, United States Lines, Pier 4, Hoboken, N. J.



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able to obstructions caused by the structural arrangement of the ships from the keel up. In the kitchen and pantry not one practical point was achieved. For that matter, no one could have improved the fixture layout, considering the kind of space provided for the steward's department. Similar faults, although not so many, can be found on a great number of ships, internationally alike.

### Faults in Galley and Pantry Layouts

Referring again to Fig. 1, it will be noticed that the ranges are placed fore and aft, instead of athwartships, as they should be on small steamers. Heavy rolling of the ship endangers the cooks in front of the ranges with pots and pans, or their contents, when sliding towards the men. In the case of coal-firing, it is difficult to hold the fire in place and feed it properly.

Obviously, the bakery and bake ovens are separated too far apart. Much time and energy are wasted by the men walking back and forth across the kitchen.

The provision of only one watertight-bulkhead opening between the kitchen and pantry, instead of the two which lead into the dining room, causes great congestion and frequent breaking of dishes.

The steam table is set up too far towards the middle of the pantry. If it were placed two feet back toward the port side, it would be handier for the men behind it because then the tables on either side of them would be within their reach and more space would be provided for the waiters to move about and better service would be given at the cold-pantry table. Furthermore the top of the steam table is fitted with a number of bain-maries. By proper arrangement of the whole kitchen and pantry, these would not be necessary. The top could be used as a handy waiters' service table, of which there is none in the entire kitchen and pantry.

The scrapping table, with the adjoining dishwashing machine, is located next to the dining room. This is never an ideal place for it, because of the clatter of dishes that can be heard for some distance in the dining room. The table is also in line with the dining room exit door, instead of two feet back. Inrushing waiters collide with others standing in front of the table and the breaking of dishes is unavoidable. Generally, scrapping tables are built too high; in this case the height is 3 feet 6 inches. This means that the waiters have to lift unnecessarily, which often causes breakage. The dishwashers could work more quickly, without waste of energy, on a lower arrangement. The most convenient scrapping table is one 3 feet high, with a 6-inch ledge all around.

An obstruction, such as the double dumbwaiter in the middle of the pantry, is a great handicap to an efficient fixture layout and dining room service. On this particular class of vessels it was installed for passenger deck service, and for an officers' mess on the boat deck. This brings up the question of whether or not it is necessary and practical on small ships to have dumbwaiter service for deck stewards, and an officers' mess on the boat deck.

### Scattered Feeding System Wasteful

A scattered feeding system is wasteful. Centralization means efficiency and economy. Very properly, we have begun to eliminate caste and class distinction on ships and, as in this instance, combine the deck and engineer officers in one mess. We can go further by having all officers of all departments eat in one mess. Merely for the convenience of a few deck officers (in this case it is not even convenient for them), the building of a mess on the boat deck is not sufficient to warrant it there. Furthermore, it compels the engineer officers to walk through passenger passages and three decks up. All the officers have to walk over open decks to reach the mess. It would be a great deal more convenient for them to have their mess near the general feeding center. The food could be served with greater appetizing effect than is possible with a dumbwaiter service. Moreover, a food-warming system and steam table, ice box, coffee urns and dishwashing sinks for the mess could be eliminated, since the food would be brought directly from the nearby kitchen. Thus the men would be better served, costly fixtures saved, and an ideal space made available for passenger or officer quarters where the present boat deck mess is located.

As to passenger deck service on small vessels, a dumbwaiter is generally not necessary when a direct way leads from the kitchen and pantry to the one or two decks that must be served. On the other hand, a deck booth—not necessarily a fully equipped pantry—is of greater value, but it is often not considered.

With all other things more advantageously arranged, both dumbwaiters would not have been essential. Without them, a good pantry system could have been designed, a dumbwaiter servant could have been eliminated and an unobstructed space would have been provided for the waiters to move about in.

A warm pantry is not an ideal location for a wire-screened bread room, especially since a roll-warmer and two egg-boilers are installed right next to it. Within a day or two the bread will have become sour and dry.

### Needless Noise Should Be Eliminated

In many cases, little consideration is given to the problem of making kitchens and pantries as noiseless as possible. In the arrangement shown in Fig. 1 there is an enormous fan motor in the pantry, and an oil pump in the kitchen, both in plain view. Besides other disadvantages, the noise caused by these machines compels the waiters to shout their orders. This, together with the clatter of dishes next to the saloon doors, is annoying to the passengers. To subdue it as much as possible, a vestibule with double-acting swing-doors leading into the saloon was necessary. Fewer doors to be opened by the waiters during the service means less congestion and breaking of dishes as well as quicker service. Under more favorable conditions, mere screens, as shown in Fig. 2, would be sufficient, providing an arrangement that is at all times the most satisfactory and least expensive. Other disadvantages and shortcomings could be pointed out, but, as an illustration, the foregoing will suffice.

Suppose now the kitchen and pantry are reconstructed with the object of obtaining the greatest efficiency and economy. Fig. 2 shows one of several possibilities. The intention, here, is merely to illustrate how, in a much smaller space, a more suitable kitchen and pantry can be built, if the right kind of space is provided.

### How the Faults May Be Corrected

In Fig. 1 it was found that the bulkhead separating the kitchen from the pantry was the main obstacle to a better layout. By setting it back from the passageway in a straight line with the forward end of the engine hatch, and by adding the space occupied by the gyro compass, toilet, lockers and stairway between the engine and boiler hatches, it is possible to lay out the units indicated in Fig. 2.

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The stairway is not essential, since the main stairway is but 40 feet away, and an additional stairway forward leads into the dining room. The gyro compass, the larger toilet, and the lockers are placed between the main stairway and the engine hatch instead of forward of the hatch as originally. Thus approximately 600 square feet is gained that could be used for a butcher shop, chef's room and officers' mess, or for any other purpose desired. However, the three rooms mentioned are often not given sufficient consideration.

The butcher shop should always be closely connected with the main galley and should not be, as in many cases, on a lower deck, especially with modern *à la carte* service that compels frequent drawing or raw foodstuffs from this department. For obvious reasons, the chef's room, or at least an office, should also be near the galley. The advantages of having an officers' mess near the main feeding center have already been mentioned.

As a whole, the greater practicability of the kitchen and pantry in this reconstruction is quite apparent. With this arrangement some interesting monetary savings may be noted.

## Monetary Savings

For the same number of passengers to be served with the same variety of dishes, the service in the kitchen and pantry could be performed with two men less. In the dining room a number of waiters would each be able to take care of one more passenger because the waiters could receive and execute the orders more quickly. The number of waiters would be reduced by at least five men. Including board and wages, these seven men can be valued at approximately $90 a month each, or $6,000 a year, figuring ten months actual sea service and port days during turn-arounds. Crockery breakage, directly traceable to the present bad features, amounts to over $2,000 a year (let us say $1,700), making a total possible saving of $8,000 a year. Calculating a ship's life at 25 years, the savings would come to $200,000. With a number of such ships in a fleet—as is actually the case—one can readily see the great losses due to unscientific construction and poor layout of fixtures pertaining to these departments.

There is another bad feature of kitchen, pantry and dining room location which seems to have become dogmatic on our vessels, for it is found on even the most recently built ship. This is shown in Fig. 1, and also in Fig. 3, representing one of our newest ships. It will be observed that a hatch extends through the dining room, and another hatch partly through the dining room and partly through the pantry.

With the tendency in constructing one-class ships, an attempt was made to achieve something better by building the kitchens, pantries and dining saloons further aft than was formerly done. Thus the working spaces were carried far beyond the engine hatch and, naturally, the necessary engineer quarters and other departmental requirements prevented the laying out of a better kitchen and pantry, and, of course, the obstructing hatch made matters worse. Better results could have been secured by constructing the dining saloon, kitchen, and pantry forward, so that one hatch, say the boiler hatch, would have extended through the dining room, and the engine hatch through the pantry, allowing a wide passage in the latter between the hatch and stairway (see Fig. 4).

In the type of ship illustrated in Fig. 1, it would have been possible to build the entire engineers' quarters, etc., on the port side in line with the kitchen and pantry. This would have allowed a straight passage (indicated by dotted lines) on the starboard side and all rooms could have been made available for passengers. The kitchen and pantry could have been arranged to better

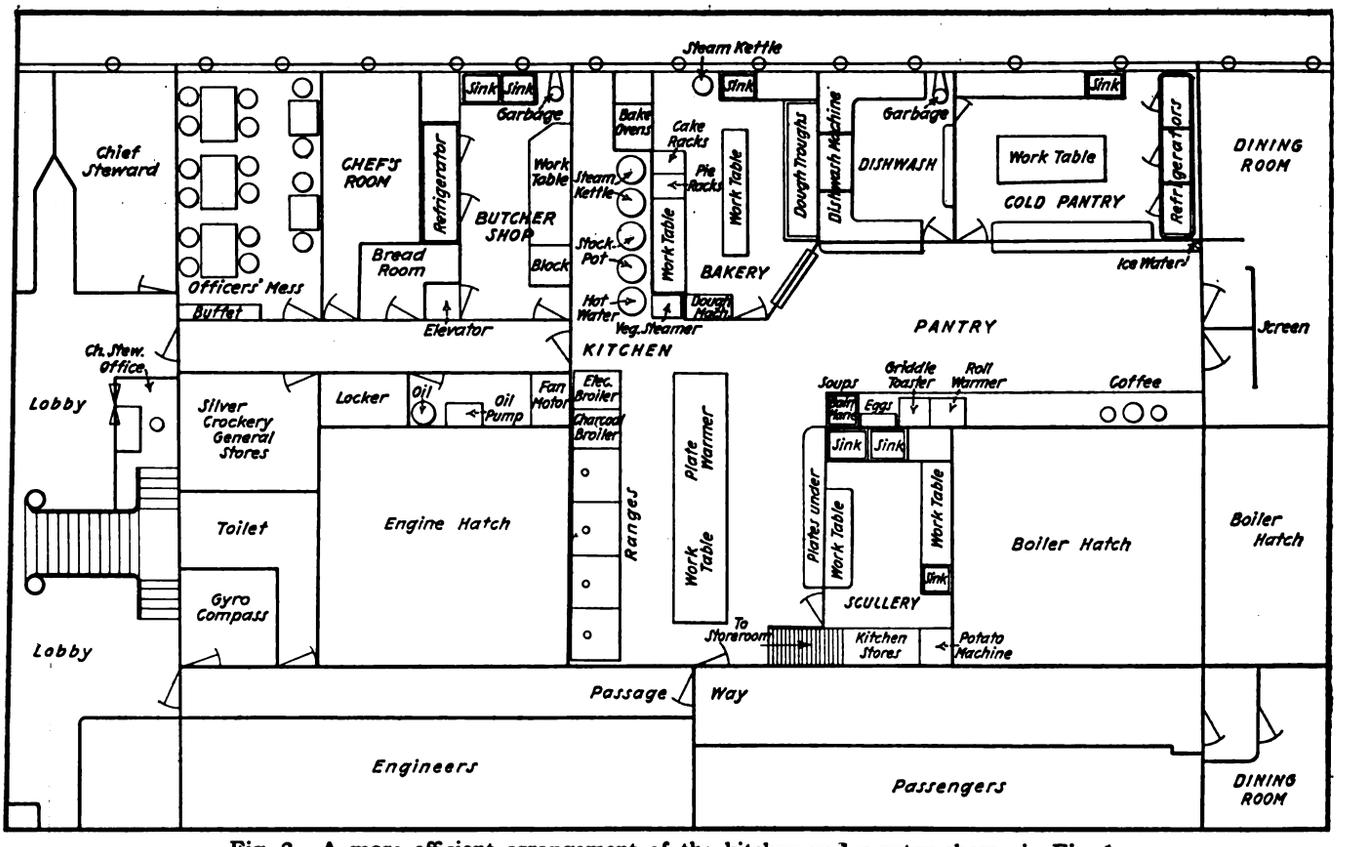


**Fig. 2.—A more efficient arrangement of the kitchen and p antry shown in Fig. 1**

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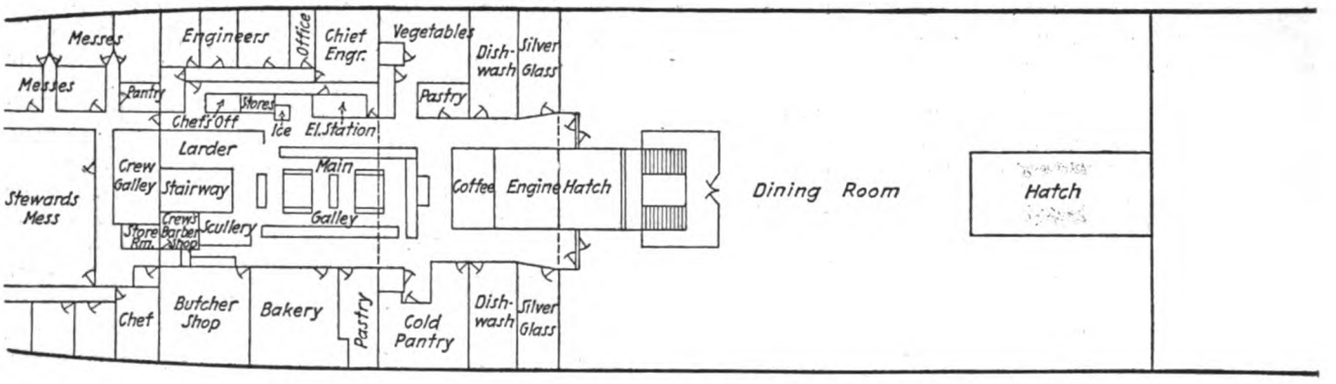


**Fig. 3.—An arrangement which shows the great disadvantage of a hatch which extends partly through the dining room and partly through the pantry**

advantage than is shown in Fig. 2, and a stairway could have been built near the dining saloon and next to the boiler hatch.

On larger vessels, where the kitchen and pantry extend across the entire width of the vessel, even greater disadvantages are encountered when a hatch extends partly through the dining room and partly through the pantry. As shown in Fig. 3, the engineers' quarters, etc., take in three-fifths of the space along the port side of the main galley section. Again, the noisiest departments (the silver and dishwashing pantries) are located on both sides next to the dining room.

This is a duplicate system, and it is the first of its kind ever constructed on ships. It has been stated with an air of considerable pride that, "as an instance of scientific economy in design, the galley service is in duplicate, so that with a lessened passenger list the whole service becomes simplified and is reduced to meet the actual demands of travel at any season. That is to say, there is a starboard and port dishwashing pantry, service counters and silver and glass pantries so that, according to the amount of the passenger list on any voyage, the one system may be cut out and the other used—with a subsequent saving in the cost of dining saloon service, but still preserving the same high efficiency."

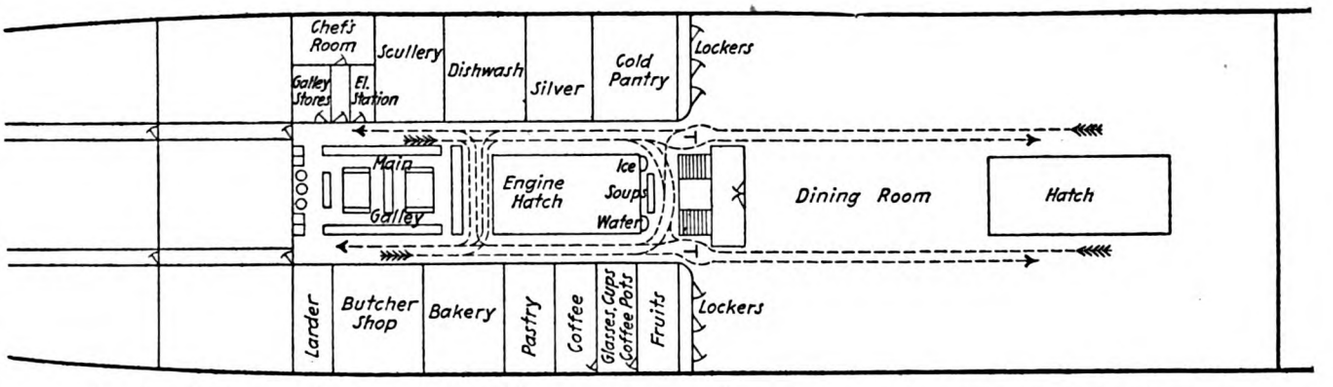


**Fig. 4.—Sketch showing how the inefficient and uneconomical arrangement in Fig. 3 might be improved**

### Why Duplicate Galley Service Is a Failure

Let us analyze this. Experienced chefs with a sense for labor-saving kitchen and pantry layouts, and for practical working conditions, look upon this arrangement with exceeding scepticism. And justly so, for the idea of duplication itself, as applied here, is against all the rules of scientific economy, whereas centralization would cover the situation thoroughly and efficiently. Experience has taught us that no matter how few passengers are carried they will choose their own tables and spread all over the dining saloon. We cannot very well turn off the lights in one-half of the room and order the passengers to sit on the other side, for we are obliged to comply with their wishes. With one-half of the kitchen and pantry system cut out, a number of waiters will have to make many roundabout trips (on account of the hatch in the saloon and pantry to get their orders. This results in delaying—not expediting—service. Furthermore the number of waiters and kitchen help always depends upon the passenger list in the traveling season, no matter whether a single or a duplicate system is used, and one cannot lay off more help with the latter system in case of a small number of passengers. On the other hand, more help is necessary with a full passenger list when operating a duplicate system. Especially is this system too expensive when the number of passengers is just above one-half the system's capacity, compelling the operation of both halves, while with a centralized system efficient service might be given with the same number of help as would be used for one-half of a duplicate system.

As an illustration, take the dishwashing pantries. Running at full capacity, a dishwashing machine needs, let us say, one rough cleaner and sorter, one feeder, one receiver and packer, and one dispatcher to store the cleaned dishes in their respective departments (in steam tables around the ranges and in the different pantries, etc.). Eight men would be needed for a duplicate system with a full passenger list, while probably five or six men could manage with a double dishwashing

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machine located in one room. The same holds true for silver, glassware, and more or less for all duplications. It is not necessary to go into the details of the higher cost of installation and larger space required for a duplicate system. They are obviously great without achieving a single practical point over the old system.

If the idea of duplication arose solely to achieve something better, it is a failure. But even without the idea of achieving something better, it was necessary, in this case, to duplicate at least two departments, since it has been decided that the best place for dishwashing and silver-glass pantries was next to the dining saloon. With that plan the builders were compelled (on account of the obstructing hatch) to provide one of each of the pantries on either side, otherwise it would have caused a service congestion of grave consequences.

The layout of a pantry system is important enough to be given careful consideration. Only a few American ships can claim fairly good kitchen and pantry arrangements, and these were made possible only because no hatch, as above referred to, obstructed the dining room and pantry. The fact that so few are in use is proof that not enough study has been given the subject. It is generally thought that waiters should get rid of their soiled dishes as soon as they enter the pantry from the saloon. This accounts for the installation of dishwashing and silver pantries near the dining room.

### Location of Dishwashing and Silver Pantries

How does this apply to a waiter's practical routine work? The average passenger begins with eating *hors-d'oeuvres,* which are served from the cold pantry. Consequently, this department should be located next to the dining room. Having delivered this order, and while the passenger eats, the waiter brings the next course, generally consisting of soup. Therefore, the station for soups should also be near the saloon. Not until the waiter serves fish, entrees or roasts does he come into the pantry with soiled dishes. Since he has to receive the three latter-named groups of edibles from the range-section, the waiter will have to pass the dishwashing and silver pantries, even if these departments are located farther away from the dining room (as illustrated in Figs. 2 and 4), and he need not make any roundabout trip but merely carry the dishes a little farther. Fruits, coffee and pastry are the last courses, and are most practically arranged together near the saloon. A pantry for glasses, cups, coffee and teapots might be installed near the coffee pantry.

The majority of passengers come into the dining room at about the same time. It is during this first rush that quick service is of greatest importance, especially the first two courses, which occupy the passengers sufficiently until the main orders have been delivered. The quicker the first two are delivered, the more time the waiter has at his disposal for receiving the following courses and serving them in the most attractive, appetizing manner. Subsequently, later passengers would not interfere so much with the waiter's delivery of soiled dishes to farther-off dishwashing and silver pantries, because he would also have to bring other orders from the ranges intended for the first-arriving diners. It is merely a matter of the waiter's intelligence; indeed, he would be foolish if he were to walk into the kitchen for each order separately.

Therefore, dishwashing and silver pantries are better situated as illustrated in Figs. 2 and 4. Next to the above-mentioned advantages, this system has the merit that cleaned dishes can be more quickly stored, because the bulk goes to the nearer steam tables around or in front of the ranges.

At any rate, these are the general lines on which a more efficient and economical kitchen and pantry system can be arranged and put into effect. Of course, the arrangement may differ here and there with the size and passenger-carrying capacity of a vessel. A separate glass pantry may not be necessary, perhaps the crockery and silver washroom can be combined, etc. The larger a ship, the better can a food-serving system be laid out. On a ship like the *Leviathan,* for instance, the hatches are so far apart that no hatch extends through a dining saloon; and the kitchen and pantry are wide enough to be laid out most advantageously. Some sub-departments (for soups, pastry, ice cream, toast, etc.) can be placed along the hatch walls without interference with other sub-pantries along the extreme port and starboard sides. In all cases, however, the vital point is: *No hatch should extend partly through the dining room and partly through the pantry; it should extend entirely through the latter, with a wide passage between the hatch and the saloon.* This means that the entire food-service center should be located farther forward. Fig. 4 shows that in such cases all waiters have a direct passage to any service station in the kitchen or pantry.

This arrangement would achieve something similar to the layout on some vessels where the dining room and pantry are separated by a passenger lobby, usually with a stairway leading through it. This layout has the advantage that noise in the pantry does not reach the dining room, even if the dishwashing pantry is the first in line of a series of pantries from the lobby on. Nevertheless, for reasons already stated, it would be better in this case to locate the dishwashing pantry further aft near the ranges. In this layout, the hatch in question is bound to be located entirely in the kitchen.

### Galley, Dining Room and Pantry Should Be on Same Level

The subject of kitchens and pantries cannot be dismissed without mentioning the objection to kitchens on a lower deck than the dining room and pantry. Dumbwaiter service and waiters walking up and down stairs increase the number of help, delay the service and waste the energy of the men. Furthermore, food warmers or bain-maries in the pantries above cause the food to deteriorate and make it lose some of its appetizing effect. With the exception of soups and some minor hot dishes, all food is at its best when served from the ranges.

For greater efficiency and for better, more economical service the kitchen, pantry, and dining room should be on the same level.

### Dining Saloons

As to dining saloons, let us turn again to Fig. 1. On the starboard side is shown the original design and table arrangement, while on the port side is indicated one of the numerous possibilities for better table layouts in a straight-walled saloon design.

The interior dining room design represents a cellar with projecting ornamental columns, and with massive, curved beams overhead. A heating and ventilating system is fitted above and below each port, with small lockers at either side. As such, no other kind of tables but round ones fit symmetrically between the columns. Replacement with square or rectangular tables would result in a loss of seating capacity. The lockers below the ports would be made useless for the waiters during the service. The passengers sitting along the hull-line might be too uncomfortably near the ventilating system. The

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opening, closing, and cleaning of the ports would be even more difficult than at present with a two-foot reach from the inner wall.

While speaking of ports, it will be found that they are generally placed above the table for the passengers. This arrangement is not as practical as when they are between two passenger tables and above the waiters' service tables or racks, which can be easily removed when desired (see Fig. 5). Ports above stationary pas-

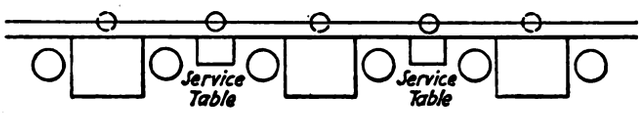


**Fig. 5.—Arrangement of ports in dining room over waiters' service tables**

senger tables—especially above square and rectangular tables close to the wall—are hard to reach for opening, closing and cleaning. For any or all of these purposes it is necessary for a person to step on the tables. Furthermore, a port that is open during the service, while it might be welcomed by the passengers sitting near the center of the saloon, might be annoying to passengers sitting right under the ports along the hull-lines; it also has the disadvantage that the food on the tables cools too quickly. All this could be overcome by having the ports installed over the waiters' service tables or racks.

Long tables for *table d'hôte* service are a thing of the past, and even tables with more than four chairs are seldom in demand. Modern travelers desire tables for two, three, and four persons. In the dining room shown in Fig. 1 round tables for six, of which a few can be enlarged for eight or nine persons, are generally used, giving a maximum seating capacity of 205 persons.

It is the interior design, the projecting columns, more than anything else that makes a more advantageous and symmetrical rearrangement impossible. The approximately one-hundred square feet of actual floor space occupied by the columns and adjoining ornaments do not mean so much as the desire of having straight lines for a suitable table layout. With a suitable rearrangement, not only would the beauty of the room be enhanced, but about sixty more persons could be seated than in the present arrangement.

Fig. 1 shows tables for two along the port side. It is advisable to have such tables made large enough to seat a third person, and also to have the tables for four made large enough to allow the seating of one or two more persons at the ends.

With this seating capacity increased to 270 persons, there still remains abundant room for the waiters, and, what is most important, sufficient space for the waiters' service tables, a matter often neglected.

## Capacity of Ship Determines Steward's Equipment

When rebuilding ships with an increase of passenger capacity over that originally provided, or when vessels are shifted to other routes than those for which they were originally intended, conditions are almost always encountered in the steward departments that are not only costly to the shipowners but which also sometimes reach the point of calamity.

With an increase in the ship's carrying capacity, the kitchen, pantry and storeroom are often given too little thought. It is evident that an increased number of passengers will require larger pots and pans for the preparation of the meals. This again calls for larger ranges, perhaps, and larger potwash sinks. Of course, the number of pieces of crockery, silver, glasses, etc., increases and the old dishwashing system may not have the requisite capacity. Ice boxes, service tables and other fixtures may need enlarging also. And, most important of all, greater quantities of provisions may need increased storage space. This feature is frequently neglected. Some years ago a number of ships were transferred from short northern routes of twenty-five day's round-trip duration to tropical routes lasting several months. But the cold storage space was not enlarged, the refrigerators had to hold three or four times the quantity of provisions for which they were originally intended, and the refrigerating machines could not produce the necessary temperature during tropical runs.

It frequently happened that meats, fresh fruits, and vegetables were piled up ceiling-high. Every conscientious steward lives in constant fear under such conditions and at times some have (flatly, but rightly) refused to go out on such vessels. The losses are, naturally, enormous and compel the purchasing of provisions in almost every port of call, which in itself, for obvious reasons, is not economical. The cost for improvements right at the start would in many instances have paid for itself several times in the long run.

But there are also ships where the storage space is far out of proportion to the passenger-carrying capacity. The ships referred to in Fig 1 were designed for 175 first-cabin passengers, but the grocery storeroom is large enough to hold provisions for 2000 people over a period of 30 days. With the present capacity of 800 passengers and crew, there is some 5000 cubic feet of excess space which could be used to better advantage.

Another bad feature on many ships is the numerous high sills or coamings of watertight-bulkhead doors. They can be, and have been, eliminated on some vessels. On the short stretch of less than 80 feet, on the type of vessels illustrated in Fig. 1, there are three such sills in the first-cabin passage leading to the dining room. In the kitchen and pantry the waiters have to step over two sills each time when going and returning with orders. The hazard of accidents is always present.

## Centralization of Crew Messes

The crew-mess system also could be greatly improved. A couple of years ago the writer published an article which urged the centralization of all crew messes. This article was illustrated by the sketch shown in Fig. 6.

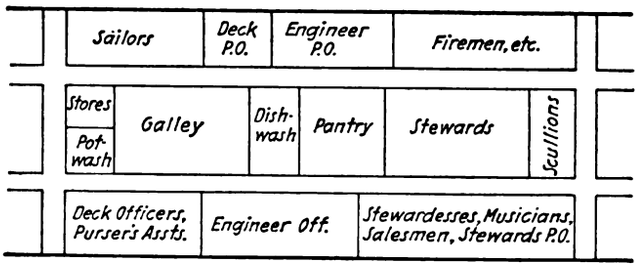


**Fig. 6.—Plan for centralized feeding of crew on large vessels**

It should be understood that this plan is intended for large vessels where a crew of over 1100 must be taken care of. However, it illustrates the basic idea that all messes should be located near one galley and pantry on the same deck. In this respect it is gratifying to see the idea put into practice on one of our new ships—the *Malolo*. Of course, being a one-class ship, the centralization was much easier, especially as to the location of the messes. On ships with two and three classes

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of passengers greater difficulties would arise. Nevertheless, a space for centralization can be found on any vessel.

At present the feeding of the crew is generally too scattered. Messes are located on many different decks, hundreds of feet apart, and often just as far from the galleys. Much of the food's appetizing effect is lost by the time it is served. The waste of food is enormous, considering that messmen have to carry it from the kitchens to the messes in large containers and there keep it hot in bain-maries or in steam tables. Naturally in this way much more food is carried to the messes than is actually consumed, and the remainder is dumped. Centralization would avoid this because the individual portions are brought directly from the nearby kitchen and pantry using the same service system for the crew as is used for the passengers. This would eliminate the costly installation of ice boxes, water and coffee urns, steam tables, bain-maries, dishwashing sinks and other fixtures in all messes. The messes would require less space and fewer men would be able to perform the same service, thereby saving, in addition to wages, sleeping space and food.

### Better Service to Crew

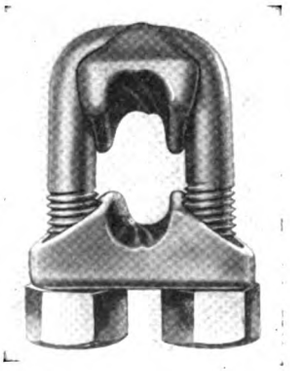
With centralization there follows, automatically, uniform cooking, resulting in serving the same kind of dishes for all, an economic factor not sufficiently realized. Issues from the storeroom also would be simplified. But what is most important, a more effective food control could be established.

Centralization of crew messes could be located below the waterline, since the mess rooms are occupied only a short time during the day. For obvious reasons, whenever possible, the location should be in direct connection with the main storerooms and the amidships galley.

## Eureka Cable Clip

A CABLE CLIP with a large holding surface has been put into production, in a full range of sizes, by the Eureka Metal Products Corporation, North East, Pa. The clip, according to tests, has shown its ability to carry three times the maximum load of an ordinary clip when used on wire rope or messenger strand.

The large surfaces of both top and bottom plates are grooved for the lay of the cable, so that neither of the cables is gripped by the U-bolt. The clip is rugged in construction and consists of only four parts. A special feature is the extra grooved jaw which is peened to the U-bolt.



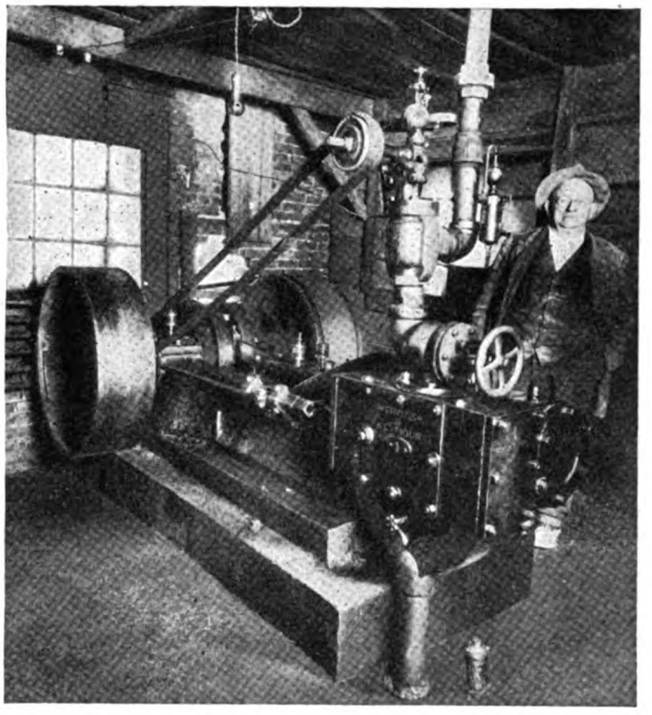
Triple-grip cable clip

The grooved surfaces of this clip provide three times the grip that is obtained in the usual cable clip, which increases the efficiency and safety of this device.

The double-grooved surfaces form a perfect loop which, under heavy loads, equalizes the stresses on the cable. These surfaces also prevent any distortion of the cable due to tightening of the clip.

## Manufacturer Buys Back First Engine

THE McIntosh & Seymour Corporation of Auburn, N. Y., has recently repurchased the first engine produced by that firm. This engine was built in 1886 by John E. McIntosh and James A. Seymour of the firm which has since developed into the present corporation. The engine is rated at 40 horsepower and runs at 300 revolutions per minute. It has had two owners and was, at the time of its rediscovery, in service in a lumber mill at Moravia, N. Y. The old engine after 41 years of active service is still in satisfactory operating condition.



First McIntosh & Seymour engine becomes property of company again

## Graphite Used for Sealing Joints

THE Joseph Dixon Crucible Company, Jersey City, N. J., has developed a paste known as "Graphite Seal" for sealing screw threads and flange and gasket joints of pipelines carrying hot or cold oils or gasoline.

This form of graphite expands when subjected to heat and makes leakproof joints that hold under all conditions of service. The joints, however, may be opened with ease at any time without delay or damage to tools or fittings. This product may also be used on handhole and manhole plates or wherever there is a flange and gasket connection.

## New Aluminum Alloy Developed

THE Sheet Aluminum Corporation, Jackson, Mich., has announced the development of an entirely new alloy of aluminum to be known as "Hyb-Lum." The new product employs nickel and metals of the chromium group, instead of the usual alloying elements of copper, manganese, silicon and magnesium. "Hyb-Lum" is non-tarnishing and non-corroding.

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# Vibration of Ships

## Hull vibration—Floor and deck vibration—Foundation resonance—Critical speeds of compound systems—Balancing

By Thos. C. Rathbone*

THE advance in knowledge of the subject of vibration of ship structures has been largely brought about through the work of Dr. Otto Schlick. His outstanding contributions were his well-known pallograph, the methods for determining the characteristics of hull vibration with its relation to periodic forces in the propelling machinery, and the process of engine balancing known as the Yarrow-Schlick-Tweedy system.

On the earlier ships equipped with relatively slow-speed reciprocating engines it was a common occurrence to encounter serious hull vibration within the operating range of speed. The answer was, and still is in many cases, to avoid this particular speed, or to pass through it as rapidly as possible. It was early recognized that a ship, supported throughout its length in water, has a natural fundamental mode of vibration about two nodes, located approximately a quarter to a third of the length from each end, with a definite natural frequency corresponding to this mode. If the periodic forces in the machinery occur at or very near this natural frequency, the cumulative properties attending resonance phenomenon allow vibrations of large amplitudes to build up, which are limited only by the relation of the damping force to the exciting force. It was also recognized that the location of the machinery with respect to these natural nodes is to be taken into consideration. The "rocking couple" is most effective when the engine is located directly at a node (for the reason that the vibratory motions on either side of the node are opposite in direction), and purely "static" unbalance forces are most effective when applied at the antinodes—either at the middle or at the extreme bow and stern.

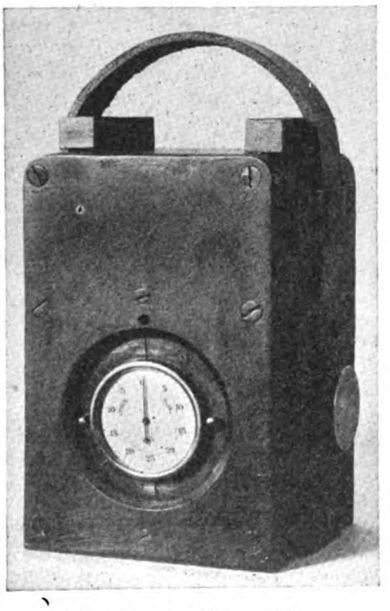

Fig. 1.—A vibrometer

### Hull Vibration

There are three other fundamental modes of ship vibration, which may or may not assume importance, depending on the frequency, location and direction of exciting forces. The second mode is the vibration as a beam in the lateral direction, which is somewhat similar to the first mode considered. Third, we have the torsional mode of vibration, which in the fundamental consists of a twisting or rotation of the forward part of the ship in one direction and the after part in the opposite direction, about some node near the midship section. Lastly, the hull may set up longitudinal vibrations, running from stem to stern. Vibration of this type is ordinarily not important, as the frequency is high, and its direction is perpendicular to the plane of action of the usual exciting forces.

As the speed of the propelling machinery is increased, the hull attempts to adopt new modes of vibration with corresponding new nodal locations to accommodate itself to these forced frequencies. Vibrations occasioned by unbalance in high-speed turbines are at frequencies so much higher than the fundamental hull frequency that they would not be expected to have any effect on this fundamental mode. Instead, with severe forces, we would find the entire ship vibrating in a queer manner, with a great number of antinodes, or localized vibrating spots, and the corresponding nodes or quiet points scattered throughout the ship.

This type of vibration is most troublesome and annoying on shipboard, as it is in land power plants. Sometimes this local vibration is severe even when the primary disturbing forces are small, due to acute resonance. In such cases, the vibration can easily be overcome by relatively simple means.

### Floor and Deck Vibration

In Fig. 1 is shown a simple form of vibrometer, built on the seismometer principle, which will indicate the amplitude of vibration in any direction, in thousandths of an inch. With this instrument, the character

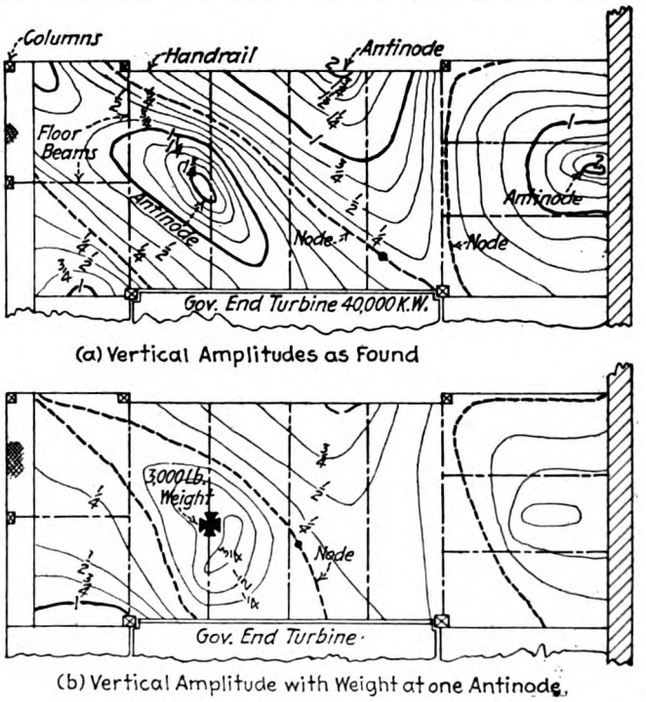


Fig. 2.—Floor vibration

* Experimental engineer, South Philadelphia Works, Westinghouse Electric & Manufacturing Company.



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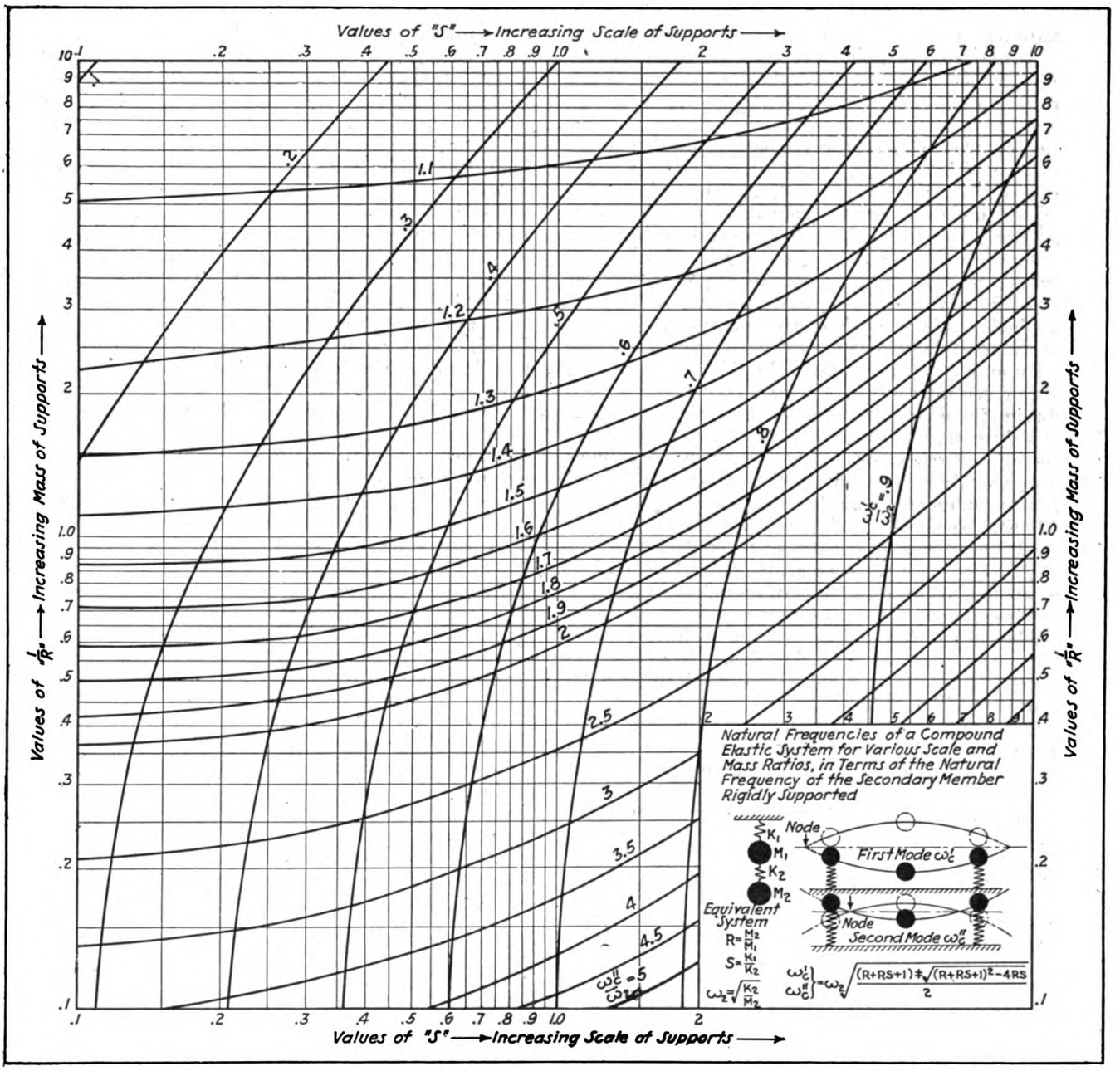
Values of "S" ⟶ Increasing Scale of Supports ⟶
Values of "1/R" ⟶ Increasing Mass of Supports ⟶
Natural Frequencies of a Compound Elastic System for Various Scale and Mass Ratios, in Terms of the Natural Frequency of the Secondary Member Rigidly Supported
Node
First Mode ω'c
Node
Second Mode ω''c
Equivalent System
R=M2/M1
S=K1/K2
ω2=√(K2/M2)
ω'c / ω''c = ω2 √((R+RS+1) ± √((R+RS+1)²−4RS)) / 2

**Fig. 3.—Critical speed coefficients**

of vibration in any complex structure can be explored, and the nodes and antinodes located, as well as the direction and plane of the vibratory motion.

In Fig. 2 (a) the vertical amplitudes found on the flooring of a power plant adjacent to a large steam-turbine generator are shown plotted in the form of a topographic map, the contour lines passing through points of equal vertical amplitude. The nodes and antinodes are clearly defined. In Fig. 2 (b), the reduction in vibration brought about simply by placing a weight on the floor at an antinode is apparent. The added mass changed the natural frequency of the floor, which evidently had been near the speed of the turbine, 1800 revolutions per minute.

Such simple remedial measures have wide application on shipboard. A great deal of the conspicuous localized-vibration encountered is directly due to resonance, and as such may be cured either by changing the mass or the elastic scale of the local structure so that its natural frequency lies outside the speed range.

## Foundation Resonance Calculations

Marine propelling machinery, however, unlike that in land power plants, is not ordinarily operated at an accurately-fixed speed. The speeds of machinery in most land plants are controlled by governors to within remarkably close limits; in fact, the constancy of the frequency of current supplied the ordinary householder has permitted the successful use of synchronous motor clocks, operated from the light socket. Problems in resonance are therefore much simpler, as the structure needs to be insured against natural frequencies occurring near this one fixed-frequency only.

In spite of this simplification, however, it is extremely difficult to calculate even the major fundamental frequencies of large land structures from the design. There has been a good deal of literature appearing on this subject recently, especially in the foreign technical press, and elaborate methods for calculating structural frequencies have been advanced. A glance

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at the assumptions glibly made to simplify the problem indicates the degree of accuracy we may expect of the particular solution.

These methods deal only with the fundamental major modes of vibration, i.e., the vertical, lateral, longitudinal, and perhaps one or two of the "twisting" modes. In practice, we find structures vibrating in all manner of modes, which in many cases cannot even be guessed at from the design without a knowledge of the behavior of similar structures gained by actual experience. Thus, on many otherwise proper structures we encounter disagreeable resonance in unexpected ways. In Europe, the land practice on large power installations has been in favor of massive concrete foundations, which, aside from their great inertia, possess inherent internal-damping properties which discourage large amplitudes at resonance. In this country, with its greater central stations, the past tendency has been largely in favor of the structural steel foundation. The disadvantages arising from their great facility for setting up and transmitting large vibratory amplitudes have been made subservient to the advantages gained from economy of space and erection time.

With this background of difficulties encountered in land practice at fixed frequencies, it might well be expected that vibration troubles are magnified many fold in an all-steel ship structure subjected to vibratory forces throughout a gamut of frequencies. It is quite remarkable then that ships operate with an unexpectedly small amount of vibration. The friction-damping effect of water on the submersed area of the hull has been cited as an explanation. No doubt this type of damping is very effective. Modern methods of dynamically balancing the turbine rotors also have contributed to the result on ships so equipped.

### Critical Speeds of Compound Systems

More attention is lately being given to the engine foundations, in the attempt to avoid major natural frequencies occurring within the speed range. The problem, as has been indicated, is more complex than for land installations, yet it appears to be possible to take care of one or two of the major modes, with certain assumptions as to rigidity of the hull itself.

It is popularly supposed that the natural critical speed of a turbine rotor is the speed at which the unit will vibrate badly in operation. This, of course, is not the case.

The critical speed of a rotor, as given by the manufacturer, is its calculated critical speed with the assumption of infinitely rigid bearing, and is merely a number, for reference and comparison purposes, indicating the stiffness of the rotor, and its static deflection.

But bearings can never be rigidly supported, and the mass of the stationary elements together with the elastic scale of the supporting structure comprise another vibrating system which has its own inherent natural frequency. Thus in the simplest analysis, we have a compound system comprising a rotor with its own natural frequency (rigidly supported) and a stationary mass possessing elasticity with its inherent natural frequency. The combination of the two yields two natural frequencies, or critical speeds, neither of which is the same as that of either of the members. One critical speed is lower than the spindle critical and the other is higher. The original two critical speeds disappear. The values of the "new" critical speeds depend entirely on the relative mass and scale of the foundation to the mass and scale of the spindle.

Thus, if the spindle critical is known, with its mass and elastic scale, we may so proportion the stationary mass or the elastic scale of the foundation to insure the critical speeds of the combination falling outside certain practical limits. To illustrate this point, Fig. 3 is given, showing these relations. The curves are in the form of coefficients to be applied to the calculated rotor critical speed as a basis. If, for instance, the ratios of both masses and scales are unity, two critical speeds will result, one 0.62 × rotor critical, and one 1.41 × rotor critical. It is thus seen how two identical spindles may exhibit different critical speeds in two dissimilar installations. In using the chart, it should be kept in mind that the calculations are based on ideal assumptions as to mass concentration and scale, the foundation itself assumed to be rigidly supported. Also, no account has been taken of the third possible mode of vibration with the bearings moving in opposite directions, nor of athwartship modes of vibration. These are very difficult to predict, but when acute resonance is encountered in practice, there remains the possibility of altering or adding to the structure to eliminate it.

In speaking loosely of resonance, natural frequencies, critical speeds, etc., there is a possibility of confusion as to precise meanings. The natural frequency of an elastic system is the frequency at which the system will vibrate freely and naturally, if subjected to a single disturbance and released, as, for instance, a weight suspended on a spring. A turbine spindle, standing still, rigidly supported in swivelling bearings, when struck a blow on top will vibrate up and down at its natural frequency. When the spindle is rotated in the assumed rigid bearings, resonance occurs when the rotational frequency is equal to the standing frequency, this is the critical speed. The combination with elastic bearings results in this resonance occurring at other speeds, the resonance being indicated by maximum amplitudes.

With a more complex system of several masses, each elastically supported, a number of such resonant speeds

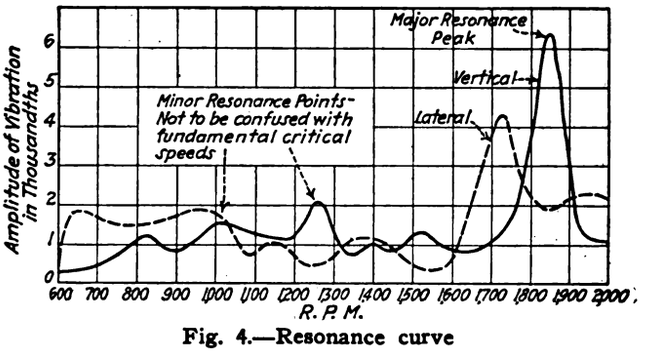


**Fig. 4.—Resonance curve**

will exist. Thus, if amplitudes are plotted against speed throughout the speed range, a curve such as drawn in Fig. 4 will be obtained. For ordinary installations, which are always complex, it is not to be expected that the curve will be a smooth line with clear-cut resonance peaks. On the contrary, there will always be a number of ripples, which might be termed minor resonance points, as well as any major peak present. These minor peak points should not be considered critical speeds.

They merely represent the varying minor or local modes by which the structure yields to the forced vibration from the rotor. The major resonance peaks, or true critical speeds, occur when the structure is vibrating as a whole in one of the major fundamental modes described.

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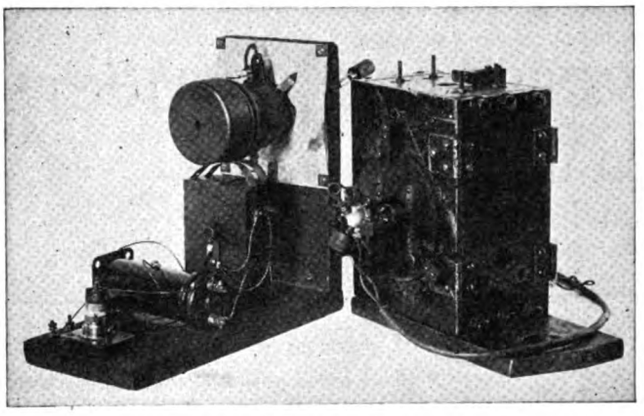

Fig. 5.—Vibration phasometer

The relative magnitudes of the peaks of vibration are also influenced not only by the amount of unbalance, but by the location. Thus, unbalance producing a dynamic couple will augment the peak at one speed and suppress another peak, and a purely "static" unbalance would have the reverse effect.

### Balancing

Most turbine rotors are given a highly refined dynamic balance by the makers by means of sensitive dynamic balancing machines of various types now on the market. In addition, instruments have lately been developed to facilitate balancing on board ship at operating speeds, when necessary. The vibrometer shown in Fig. 1, when mounted on the bearings, indicates the amplitudes of vibration, and avoids guess work in determining the result of the trial-balancing weights, in addition the data obtained with the vibrometer are used to compute the proper location and amount of required balance weights.

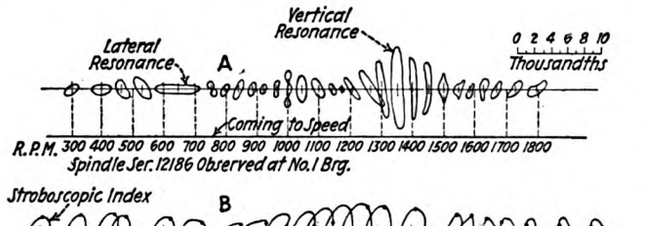
Vertical Resonance
Lateral Resonance
A
0 2 4 6 8 10
Thousandths
Coming to Speed
R.P.M. 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
Spindle Ser. 12186 Observed at No. 1 Brg.
Stroboscopic Index
B
On Load
40 50 6.00 10 20 30 40 50 7 P.M. 10 20 30 40 50 8 P.M. 10 20 30 40
Spindle Ser. 12186 at No. 1 Brg.
Impactive Interference at Bearing Pedestal - Note Rotation of Cusp
C
On Load
20 30 40 50 5 P.M. 10 20 30 40 50 6 P.M. 10 20 30 40 8:10 10 P.M.
Spindle Ser. 12187 at No. 1 Brg.

Fig. 6.—Vibration micrographs

For further investigations of vibration, an apparatus called a "vibration phasometer," a type of which is shown in Fig. 5, has been developed which not only shows the actual path of the vibratory motion, the inclination of the ellipse, etc., but by a stroboscopic method, employing a neon lamp flashing once a revolution, the instrument shows the phase relation of any point in the path of motion to a fixed datum point on the rotating spindle. This apparatus is especially useful in investigating obscure vibration characteristics and resonance conditions. Typical paths of vibratory motions observed are shown by micrographs in Fig. 6.

With the increasing use of Diesel engines for powering ships, it may be expected that the subject of ship vibration will take on added importance. Further developments will undoubtedly be made in methods of determining hull frequencies and modes of vibration as well as in methods of counterbalancing reciprocating forces of paramount importance in connection with Diesel installations. With multiple engines, running at times at slightly different speeds, "beat" phenomena will crop up, and this beat frequency may occasionally tune in with a slow transverse hull frequency to cause annoyance.

Although the present status of knowledge of vibration and means for avoiding vibration difficulties falls far short of being satisfactory, the advances made in the past few years encourages the belief that as situations develop and become acute the solutions will be forthcoming.

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# 50,000-Ton Floating Dock Being Towed to Singapore

THE larger of the two sections of a 50,000-ton floating dock for the British Admiralty left the Wallsend shipyard of the builders, Messrs. Swan, Hunter & Wigham Richardson, Ltd., on June 21, on her 8600-mile voyage to Singapore. The section is being towed by four of the most powerful tugs of the towage contractors, Messrs. L. Smit & Company, Rotterdam. These are the *Roode Zee, Zwarte Zee, Indus* and *Schelde.*

Two of the tugs are proceeding in front of the section connected by a 20-inch manila rope, which is used for this work in preference to steel, owing to its greater elasticity and to the fact that a hemp rope offers more resistance to the water under any tendency to rise suddenly under strain. In addition 5-inch Bullivant steel ropes are connected to the hemp ropes.

The first section contains most of the plant and machinery in the complete floating dock and has a towage weight of about 12,350 tons, including crew, ballast, fuel and towage gear. The average speed attained during the tow is expected to be about 3 miles per hour, and the section will arrive at its destination, the Island of Tebran Reach, near Singapore, about November 14.

In case of excessively bad weather or an exceptional emergency during the voyage, arrangements have been made so that the dock may remain stationary until conditions improve by the provision of two 5½-ton anchors and a windlass. As an additional safeguard, two divers with complete diving apparatus will accompany the dock section in the event of their services being required by the tugs or dock. The complete personnel of the tugs towing this section numbers about 80 men, while the shipbuilders are sending out on the dock a small additional number of skilled Tyneside workers.

The complete dock, which contains about 20,000 tons of steel and 3½ million rivets, was completed by the builders in the short space of ten months and will accommodate the largest warships. If desired, three destroyers can be docked abreast at the same time. It will be the largest structure that has ever passed across the Indian Ocean. The other and lighter section of the 50,000-ton dock left the Wallsend shipyard during the following week, but is expected to arrive at Suez in time to pass through the canal in proximity to the first section and is scheduled to arrive at Singapore about the end of October.

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# Questions and Answers for Engineers

## Practical information on the operation and maintenance of boilers, engines and auxiliaries

*This department is maintained to help those who desire practical information regarding engine room problems or who are preparing to take examinations for a marine engineer's license. Readers are urged to send in questions. Inquiries bearing the name and address of the writer will be answered promptly by mail. If the question is of general interest the answer will also be published in an early issue of the magazine, although the identity of the writer will not be disclosed in doing so. Anonymous communications will not be considered.*

### Bursting Pressure of Boiler

Q.—What is the formula for finding the bursting pressure of a boiler?

A.—The tensile strength times thickness of sheet times efficiency of joint divided by the radius or one-half the diameter.

### Turbine Efficiency

Q.—How great is the gain in efficiency of a turbine due to an increase in vacuum?

A.—By raising the vacuum from 26 to 27 inches increases the efficiency about 4.3 percent, from 27 to 28 inches about 5.3 percent, from 28 to 28½ inches about 4.3 percent and from 28½ to 29 inches about 4.7 percent.

### Corrugated Furnaces

Q.—What are some of the advantages gained by the use of corrugated furnaces?

A.—The corrugations add great rigidity and strength to resist the crushing strain to which the furnace is subjected. There is more heating surface in a corrugated furnace than in one with a smooth surface. The alternate expansion and contraction of the corrugated surface tends to loosen any scale that may start to form on the surface inside the boiler.

### Stripping of Turbine Blades

Q.—What are some of the causes of wear and stripping of turbine blades?

A.—As a rule turbine blades show no sign of wear, the only difference noticeable is a darkened color which is produced by the effect of the heat of the steam. Stripping of blades may be caused by wear of the main bearings, the sudden presence of a body of water carried over with the steam or insufficient clearance between rotor blades and casing or the casing blades and rotor, when heated up. Trouble with bearings is most always due to a stoppage of the forced lubrication, which results in the rapid heating and melting of the white metal causing the rotor to drop and the blades and dummy rings (if fitted) to foul.

### Effect of Excessive Calking

Q.—What are some of the injurious effects of excessive calking of boiler seams?

A.—Excessive calking is one of the causes of grooving along the edges of the seams; it also tends to raise the edge of the plate that is calked, causing looseness at the joint.

### Evaporation and Steam Consumption on Stern-Wheel Towboat

Q.—What is the evaporation per square foot of heating surface in Western river boilers such as are used on stern-wheel towboats burning oil? What is the water rate on a set of horizontal compound poppet-valve steam engines, and what is the additional water rate required for the auxiliaries? The indicated horsepower is 500 to 750.

A.—The actual evaporation per square foot of heating surface may be taken as 9 pounds, the water rate per horsepower for main engines as 16 pounds and for auxiliaries about 20 percent of the total steam for all purposes.

### Operation of Thrust Bearings

Q.—What precautions are necessary for the successful operation of horseshoe type thrust bearings?

A.—The surface of the babbitt-faced bearing rings must be exactly parallel with the faces of the thrust collar. The bearing surface of the thrust collar must be perfectly smooth and run true. The end play or oil clearance must not be excessive. The bearings must be supplied with the proper amount and quality of lubricant. Oil holes and grooves must be kept clean. All bearing surfaces must have adequate grooves with well rounded sloping edges.

### Carbon in Spray Nozzle

Q.—I am operating a 100-horsepower, 4-cylinder, 2-cycle, low-compression, hot-bulb engine, having solid injection and a fuel pump for each cylinder. Why does the hole in the spray nozzle plug up solid with carbon? This happens once in a great while, and is not caused by any change in the fuel or by grit or foreign matter in the oil.

A.—The plugging of the spray nozzle with carbon is due no doubt to a leak in the check valve controlling the injection of fuel oil into the combustion chamber of the cylinder. The problem of this type of engine is to prevent so-called "after-dripping," or in other words to interrupt the flow of fuel through the nozzle check valve so that injection will cease suddenly and no fuel oil will enter the cylinder at very slow velocity and accumulate in the immediate proximity of the nozzle, where it will coke due to lack of heat required to evaporate and burn it. The effect is very similar to that of a leaky valve—some fuel will be forced through and deposited on the inner face of the nozzle, where it will form coke and finally close up the nozzle opening entirely.



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## Causes of Loss of Vacuum

Q.—What are the principal causes of an inadequate vacuum?

A.—Air leaks, dirt in the condenser, baffles or division plates displaced or carried away will all cause a loss in vacuum. Inefficient or improperly operated pumps, insufficient circulating water, too high a temperature of injection water are other causes.

## Amount of Water Required to Condense a Pound of Steam

Q.—How many pounds or gallons of condensing water are required to condense a pound of steam?

A.—The number of gallons or pounds of condensing water required to condense a pound of steam depends upon the number of inches of vacuum and the final temperature of the condensed steam and also the initial and final temperatures of the condensing water. A rough approximation is 27 pounds of circulating water for every pound of steam condensed.

## Carbon Packing in Turbines

Q.—Explain what care must be taken in overhauling carbon packing in a turbine.

A.—After removing the end cover, draw out the first distance piece by means of packing hooks. Care must always be taken to keep the top and bottom halves as nearly as possible in the same plane in order to prevent breaking away the carbon segments as they are pushed outward by the distance pieces. When the distance pieces have been withdrawn far enough, each carbon segment should be carefully removed and placed in a box. Great care and precautions must be taken to avoid pulling the distance pieces out so far that the carbon segments drop off the small rods which pass through a hole in the segment.

## Blade Clearances in Turbines

Q.—What effect have tip and blade clearances on the efficiency of Parsons or Curtis turbines?

A.—In a Parsons turbine the efficiency depends to a great extent upon the tip clearance of the blades, the axial clearance between the rows of blading having no great influence on the results obtained. On the other hand the efficiency of a Curtis turbine is chiefly dependent upon the clearance between the nozzles and the blades, and not upon the tip clearance. Consequently in the Parsons turbine the tip clearances are made small and the axial blade clearances relatively large. In the Curtis turbine the axial clearance between the nozzles and the blades is made as small as possible while the tip clearance is relatively large. In both types steam tightness is obtained at points where the shaft passes through the casing with labyrinth or special packing. Steam or water is used as a sealing medium. Leakage by the dummy piston of the Parsons turbine is prevented by the use of dummy packing. In a Curtis turbine leakage from stage to stage is prevented by the labyrinth diaphragm packing. The clearance in all labyrinth, dummy and diaphragm packing is small, therefore, if the position of the rotor changes due to wear of bearings or thrust, this clearance will be altered. In extreme cases the gland strips will rub, which will result in the loss of efficiency in the turbine due to steam leakage by the glands. Eventually such a condition will necessitate very costly repairs.

## The Slide Valve

Q.—Explain how a slide valve is fitted to the cylinder.

A.—A slide valve has a flat face and it works on a corresponding flat face of the cylinder. In the cylinder face there are three passages which are called ports, the two smallest are the steam ports, leading to each end of the cylinder, while the larger passage is the exhaust port and leads to either the receiver, condenser, or atmosphere, whichever the case may be. The valve is contained in a steam-tight casing and is either cast with the cylinder or bolted to it. This valve chest or casing is filled with live steam when the engine is working.

## Three-Wire Generator

Q.—Describe a three-wire generator.

A.—The three-wire generator differs from the two-wire machine in that it gives two different voltages at the same time. These voltages are always in the ratio of two to one. The middle wire of such a system is called the neutral wire and it is obtained in the following manner. Leads are brought out from the rear of the armature winding at points electrically opposite each other and are connected by means of brushes to the terminals of a balance coil. The third or neutral wire of the system is connected to the middle point of this balance coil. The balance coil resembles a single coil transformer and consists of a number of turns of a suitable wire wound around a laminated-iron core. The balance coil is always external to the machine and is usually mounted behind the switchboard. A generator of this type which will deliver 250 volts between the outside terminals will have a voltage between either outside terminals and the neutral wire, of one-half of 250 volts or 125 volts.

## Reduction Gear Safety Precautions

Q.—What safety precautions should be observed in the operation of reduction gears?

A.—An ample quantity of the proper quality of clean lubricating oil must be applied to the gears at all times while they are in operation. In case of churning or emulsification of the oil in the gear case, the turbine must be slowed down or stopped until the defect is remedied. Should the supply of oil fail for any reason, the engine must be stopped until the cause can be located. When the bearings are known to be overheated, gears should not be operated until the bearings have been examined and the defects remedied. If excessive flaking of metal from the gear teeth occurs, the gears should not be adjusted until the cause has been determined; care must be taken to prevent as far as possible, the entry of the flakes into the general lubricating system. Any unusual noises should be investigated at once and the gears operated with caution until the cause is discovered. Bearings and thrust clearances should be checked at the end of each run. Whenever gear cases are open, great care must be taken to prevent any foreign material from entering into the casing. Before the casing is closed, one of the engineers should make an inspection to see that no tools, rags, etc., have been left in the gear case or on the gears. Lifting devices for the handling of gears should be carefully inspected before being used and should never be overloaded.

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# Questions and Answers Relating to Ship Design and Construction

By J. L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

*This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

### Relative Merits of Crank-Case and Separate Pump Scavenging for Diesel Engines

Q.—What are the relative merits of crank-case and separate pump scavenging for Diesel engines under 360 brake horsepower? What I am particularly interested in is the oil consumption and also which type is least susceptible to mechanical difficulties when used for workboat service.

A.—Theoretically the separate scavenging pump arrangement is superior to crank-case scavenging by reason of the fact that with the former any desired scavenging ratio may be obtained while with the latter this ratio can be only 1 to 1. This means that a higher mean effective pressure can be obtained in the cylinders with the separate pump scavenging and, for a given power at a given speed of revolution, the cylinder size is less. Conversely, with a given cylinder size for a given power, the crank-case scavenged engine must turn at a higher speed than the one with a separate scavenging pump. This difference is not great enough, however, to be very important in small cylinder sizes.

Considering fuel consumption, it is found that in actual practice the separate scavenging pump arrangement has a small superiority over the crank-case scavenging type. The difference in favor of the former will be found to amount to about 0.02 pounds per brake horsepower.

In the matter of lubricating oil consumption also, the separate scavenging pump arrangement has a slight advantage, but the operating results obtained from existing engines of the size mentioned do not give a true comparison of the effects on lubricating oil consumption of the two methods of scavenging. The reason for this is that these engines are of the trunk-piston type and most of the crank-case oil that finds its way into the clyinders does so as a result of this trunk-piston arrangement, regardless of the scavenging arrangement used. If the loss of the lubricating oil due to the oil being carried up into the cylinder by the piston, or splashed onto the cylinder walls by the rotating parts could be eliminated in both types of engine, it would probably be found that the difference in lubricating oil consumption of the two types would be greater.

It is found by experience that in small engines in which crosshead construction is used, in order to isolate the crank case, the lubricating oil consumption is cut in half.

Answering specifically the latter part of the inquiry, assuming an engine of 300 brake horsepower, operating 10 hours per day, the fuel consumption for the separately scavenged engine would be about 184 gallons, and for the crank-case scavenged engine about 192 gallons. The lubricating oil consumption would be about in the ratio of 2 gallons for the former and 2½ gallons for the latter.

As to mechanical difficulties under the conditions specified, there is little choice. Existing commercially available engines of both types have proven very reliable in service, and if properly operated and cared for either should be very satisfactory.

### Power Required for Propelling Tugs

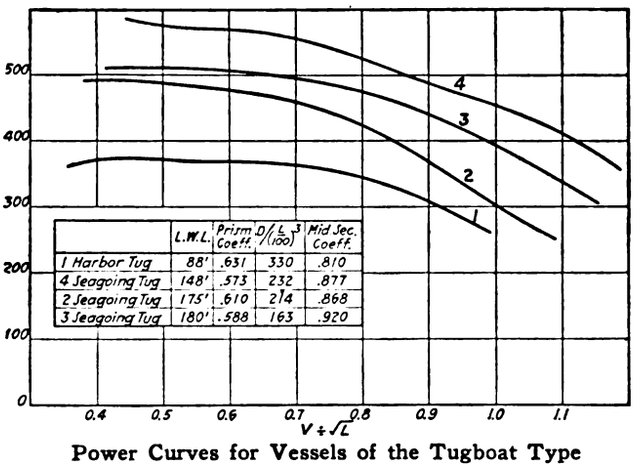
Q.—As an engineer engaged in the Diesel engine field, I am interested in learning something of power required for ship propulsion, particularly for small tugs and hulls of schooner form. In applying the Admiralty formula

$$H = \frac{D^{2/3}\ V^3}{K}$$

the value of K is a question Have you ever published an article dealing with this subject as applied to small craft in detail? If nothing has been published, can you supply me with this information?

A.—The writer possesses comparatively little information relative to the powering of short, large displacement vessels of the tug type. Such as is immediately available he has plotted in the form of curves of $\frac{D^{2/3}\ V^3}{E.H.P.}$ on a base of speed-length ratio. These are shown in the illustration.

The effective horsepower data used in preparing the




| | L.W.L. | Prism Coeff. | D/(L/100)³ | Mid Sec. Coeff. |
|---|---|---|---|---|
| 1 Harbor Tug | 88' | .631 | 330 | .810 |
| 4 Seagoing Tug | 148' | .573 | 232 | .877 |
| 2 Seagoing Tug | 175' | .610 | 214 | .868 |
| 3 Seagoing Tug | 180' | .588 | 163 | .920 |

**Power Curves for Vessels of the Tugboat Type**

above information was derived by experiment in the Washington Experimental Model Basin.

The hull forms represented by the models are considered of average excellence.

It is noteworthy that the values of $\frac{D^{2/3}\ V^3}{E.H.P.}$ generally decrease with increase in the value of the speed-length ratio. Also models having the larger values of prismatic



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coefficient show the lower values of $\frac{D^{2/3} V^3}{E.H.P.}$.

Dr. Schaffran published the results of model experiments upon launch forms. An abstract translation of his article appears in *Shipbuilding and Shipping Record*, September 30, 1926. Additional data from the same authority appeared in the same publication, issue of March 10, 1927.

At the spring meeting, the 68th session of the Institution of Naval Architects (British), Captain Chr. Blom read a paper entitled "The Future of Sailing Vessels Fitted with Auxiliary Motors." In this paper are included the resistance curves of certain sailing vessels.

At the same meeting J. Douglas Calder read a paper "Notes on the Design of Coasters." This paper contains Admiralty coefficient data.

Abstracts of these last two papers were published in *Shipbuilding and Shipping Record* for April 14, 1927.

# Communications

## Will Boilers Explode When a Steamship Sinks?

LOS ANGELES, CAL.

TO THE EDITOR:

In your questions and answers department, page 339 of the June issue, one of the questions asked was "Will boilers explode when a steamship sinks?" A few years back, motion pictures taken on German submarines during the war were shown at motion pictures theatres in this country. In several of the sinkings, the boilers did explode, and the explanatory notes called attention to this fact in one instance. As I remember it, however, there were several cases where the boilers did not explode; at least they did not appear to in the pictures.

Another question, on the same page, was, "What advantage has a turbine over a reciprocating engine in the disposal of its exhaust steam?" An additional advantage of the turbine, for certain forms of service, is that the turbine may be bled at one or more points for heating the boiler feed water. This results in more efficient utilization of steam in the turbine, the recovery of part of the heat that would be lost in the circulating water and the use of a smaller condenser, circulating pump and condensate pumps.

HOWARD LIVINGSTON.

## Questions and Answers

BROOKLYN, N. Y.

TO THE EDITOR:

I have just been reading David Gaehr's article on "Suggestions for Licensed Engineers on Shipboard," published on page 449 of the August issue. While I am in accord with Mr. Gaehr's ideas and opinions on the whole, there is one point in particular with which I am not in full agreement, and that is in the second paragraph where he classifies "Questions and Answers" under the category of bad methods of acquiring useful information. It is true that the catechetical or "Question and Answer" method of acquiring knowledge is not the best, but it is better than not any method at all and that it has a place is evidenced by the fact that most all kinds and grades of publications have Questions and Answers columns under various captions.

The question and answer method of imparting information can never take the place of a regular prescribed course of instruction in any given subject, where basic principles and fundamentals must be mastered first, as stated by Mr. Gaehr, nor was it ever intended to do so. Rather is it a method of convenience, a service to those who do not want to go into a subject in its entirety, but who do want an answer to a specific question. Of course it should go without saying that to be of any real value the answers must not be incorrect nor misleading, even though they do not tell the complete story of the subject at issue.

Again, there are men who have made a study of fundamentals and have gone through with a course of instruction in some recognized institution of learning, who still desire answers to certain questions that may not have come within the scope of their course. Probably such a man would not require a long-drawn-out answer covering details from fundamentals up, and would be satisfied with an answer to his question that could be correct and not misleading although brief in expression.

To a certain extent at least, the "Question and Answer" method of conveying information is relatively similar to courses of instruction by correspondence that have helped many a man who would otherwise have had to go without an education. Such courses are not as good as a college course, but to the man who cannot go to college it is infinitely better than nothing. Likewise the "Questions and Answers" method has a place and is likely to have indefinitely. However, Mr. Gaehr's article is timely and praiseworthy and his suggestions are commendable.

CHARLES J. MASON.

# New Books

THREE-FIGURE MATHEMATICAL TABLES. By Henry Baker, M.Sc., Ph.D. Size, 8¼ by 5¾ inches. Pages, 7. London: W. & R. Chambers, Ltd. Price, 3d.

With the aid of these tables, it is unnecessary to subtract logarithms when working problems of division. These tables use addition for all problems. Sub-totalling due to subtraction is also avoidable.

DIESEL ENGINE RUNNING AND MAINTENANCE. By Philip H. Smith. Size, 7¼ by 5 inches. Pages, 157. Illustrations, 87. London, 1927: Constable & Company, Ltd. Price, 3s. 6d. net.

This manual embodies a first-hand experience of Diesel engines extending over nearly a quarter of a century and is intended to help the practical man to secure maximum reliability consistent with reasonable all-around economy in the operation of a Diesel engine plant. The book has special reference to land practice, but with the exception of Chapters I, II and XVII, the discussion applies to the marine type of Diesel engine.

Theoretical design is not covered in this work, but the maintenance and repair of engines in operation are fully covered. Methods of predetermining engine troubles and avoiding extensive repairs are explained in simple language that may easily be understood and appreciated by the Diesel-engine operator.

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# Personal

**L. S. Andrews,** formerly inspector for the **United States Shipping Board,** has been appointed assistant port engineer of the **American Republics Line,** with headquarters at Pier 3, Army Base, Brooklyn, N. Y.

**A. W. Cross,** formerly naval architect for the **American Shipbuilding Company,** Cleveland, Ohio, has been appointed assistant to the president and will be in charge of all technical matters pertaining to sales and new business. **John E. Steinman,** formerly superintendent of the company's Lorain yard, has been appointed general superintendent of the company.

**John F. Galvin** of New York city, was elected chairman of the **Port of New York Authority** at a meeting held July 12. Mr. Galvin, who has been vice-chairman, succeeds former Governor **George S. Silzer** of New Jersey, whose term expired recently. Mr. Galvin was originally appointed a commissioner of the Port Authority in 1923 and was renamed for a full five-year period in 1926 and served as vice-chairman for several years. He is president of the **Metal Stamping Company** of Long Island city, which he established in 1888, and is an officer and director of several other business enterprises and banks.

John F. Galvin

**Georges Philippar,** chairman of the board of the **Compagnie des Méssageries Maritimes** and of the **Société des Services Contractuels des Méssageries Maritimes,** has been appointed chairman of the **Compagnie Générale Transatlantique,** succeeding the late **John Dal Piaz.** Georges Philippar was born October 16, 1883. In 1912 he first became affiliated with shipping interests, when he was appointed secretary to the board of the Méssageries Maritimes. He was promoted to assistant manager in 1914, then to general manager in 1918 and finally as a director in 1921. In 1925, following the death of **Felix Roussel,** he was elected chairman of the Méssageries Maritimes. M. Philippar's activities have not been limited to the control and supervision of the Méssageries Maritimes, however, for he has also been chairman of the **Société Provencale de Constructions Navales** and of the affiliated **Société Provencale de Constructions Aeronautiques.** Among other positions held by Georges Philippar are those of vice-president of the board of the **Compagnie Fraissnet;** vice-president of the **Société des Consommateurs de Petroles,** and vice-president and managing director of the **Credit Foncier de Madagascar.** He has been a member of the **Academy of Marine** since its foundation.

**Samuel S. Sandberg,** who was recently appointed to succeed **Phillip S. Teller** of San Francisco as a member of the **United States Shipping Board,** has been tendered a resolution of fidelity by the **Los Angeles Steamship Owners Association.** Commissioner Sandberg was born in Surrey, England, in 1867 and began his sea career at the age of twelve as an apprentice on an East Indian sailing ship. At the age of seventeen he made his home in San Francisco where he became naturalized and continued his seafaring career with the **Pacific Mail Steamship Company.** In 1910 Commissioner Sandberg retired from the sea, to make his home in Los Angeles, Cal., where he became the representative of a steamship company in the intercoastal service. In 1916 he made a survey of the countries in the Far East after which he was appointed port captain of the **Luckenbach Steamship Company** with headquarters in New York city. In June, 1922, he accepted an appointment by the **Board of Harbor Commissioners** as traffic manager at Los Angeles Harbor, supervising the physical operations of that port until May 31, 1928 at which time he was appointed by the President as one of the commissioners of the United States Shipping Board.

Samuel S. Sandberg

**General William C. Heppenheimer,** of Jersey City, N. J., was recently appointed a member of the Port of New York Authority, succeeding former Governor **George S. Silzer,** who had been chairman of the body during the past year.

# Obituary

**Robert Weeks Kelley,** former president of the **Navy League** and prominent as a financier, died of pneumonia in Paris recently. He was 75 years of age.

**Frank M. Leavitt,** inventor of the Bliss-Leavitt torpedo and other projectiles which are used by the **United States Navy,** died at his home in Scarsdale, N. Y., on Monday, August 6. Mr. Leavitt was 72 years of age.

**Willard J. Blake,** president and general manager of the **White Star Tug Line,** Buffalo, N. Y., died recently at his home in Buffalo. Mr. Blake was 50 years of age.

**Charles L. O'Connor,** vice president of **M. &. J. Tracy, Inc.,** 1 Broadway, New York city, died of heart disease recently at his home, 44 Haven Esplanade, Silver Lake, Staten Island, N. Y. Mr. O'Connor was 53 years of age.

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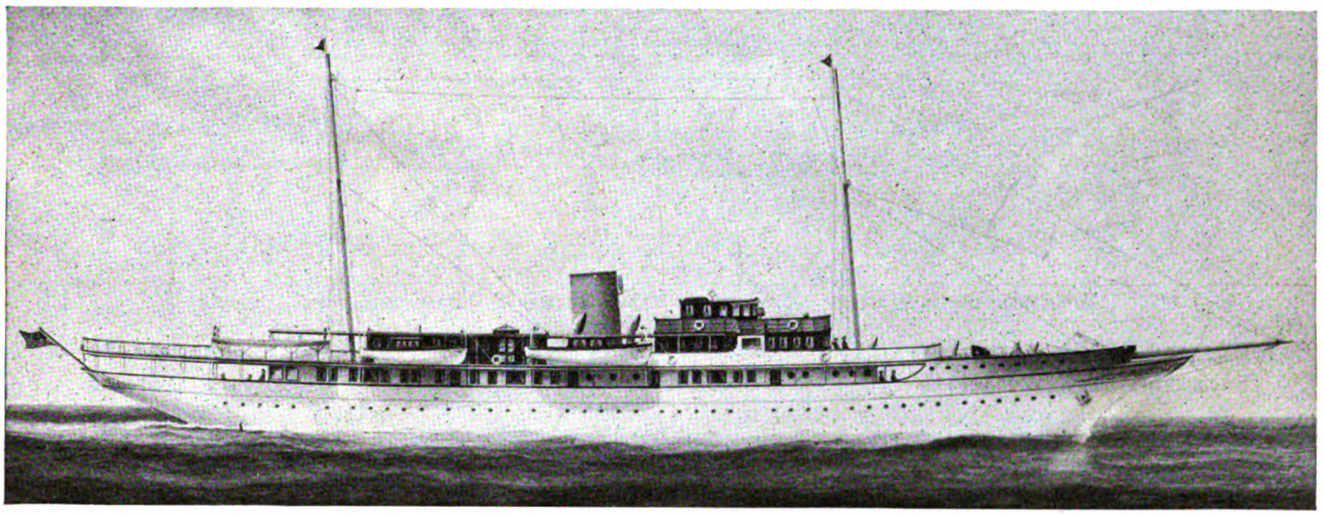
# Ship Construction and Repair News

## Proposed work—Bids asked—Bids received—Contracts awarded—Current activities



261-foot Gielow-designed Diesel yacht to be built at Bath Iron Works

### Contracts for Four Private Yachts Awarded to American Yards

A CONTRACT for the construction of a twin-screw all-steel sea-going Diesel yacht, to cost approximately $1,000,000, has been awarded to the Bath Iron Works Corporation, Bath, Me. The yacht will be 261 feet in length, with a beam of 35 feet 6 inches, and a draft of 14 feet 6 inches. She will be powered with two 1200-horsepower Bessemer Diesel engines and will have an estimated speed of 15 knots.

Three other yacht contracts were also recently awarded as follows:

A 209-foot auxiliary schooner Diesel yacht, to cost $850,000, for Carl Tucker, awarded to the George Lawley & Son Corporation, Neponset, Mass. The yacht will have a 34-foot beam and a 14-foot draft.

A 130-foot twin-screw gasoline houseboat, to cost $275,000, for W. H. Vander Poel. This yacht will be constructed at the Fogal Boatyard, Miami, Fla. She will be equipped with Sterling engines and carry a crew of 14.

A 165-foot steel twin-screw Diesel yacht, to be built for a Detroit yachtsman at a cost of $525,000. This yacht will have five double staterooms with four baths. A pair of 425-horsepower Bessemer Diesel engines will be installed. All of the yachts were designed by the firm of Henry J. Gielow, Inc., 25 West 43rd street, New York city.

### Barge Contract

THE Dravo Contracting Company, Dravo Building, Pittsburgh, Pa., has been awarded a contract for the construction of two steel barges for the Basic Products Company, Kenova, W. Va. The price involved was not announced.

### Plans Being Drawn for Two Matson Navigation Company Liners

INFORMATION has been received that plans are being prepared under the supervision of Joseph T. Tynan, general manager of the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Cal., for two liners for the Matson Navigation Company, 215 Market street, San Francisco, Cal. Although details of the new vessels are not yet available, it is believed that they are being designed for the Australian service conducted by this company.

### Issue of Plans for Four Export Liners Pending Shipping Board Loan

PLANS and specifications for the proposed ships of the Export Steamship Corporation, 25 Broadway, New York city, have been completed and are now in the hands of the Export Line officials. The date of issue, however, is being held up awaiting favorable action on the corporation's application for a loan from the Shipping Board's construction loan fund.

The new ships, plans and specifications for which were prepared by George G. Sharp, naval architect, 30 Church street, New York city, are to be of the single-screw, shelter-deck type, 450 feet long between perpendiculars, 59 feet molded beam and 46 feet 6 inches molded depth to the shelter deck. They will have a deadweight tonnage of 9,500 on a draft of 27 feet 10½ inches.

The vessels are to be operated between North Atlantic ports of the United States and ports in the Mediterranean.

### Tebo Yard Awarded Contract for New York City Ferryboat

A CONTRACT for the construction of one double-ended steel steam ferryboat for the Department of Plant and Structures of the City of New York has been awarded to the Tebo Plant of the Todd Shipyards Corporation, Brooklyn, N. Y., at a price of $353,241. The new ferryboat is to have a length over guards 151 feet; length outside end posts 148 feet; beam over guards 53 feet; beam, molded, 37 feet 6 inches; depth to top of beams at side of guard 14 feet 3 inches; draft 8 feet 3 inches, and displacement 610 tons. Bids for the work were received June 29.

### Contract for 126-foot Yacht Awarded Pusey & Jones Corp.

A CONTRACT for the construction of a Diesel yacht was awarded to the Pusey & Jones Corporation, Wilmington, Del., on August 16. This yacht, designed by John H. Wells, Inc., New York city, will be of steel construction and will have a length of 126 feet overall and 118 feet on the waterline. She will have a beam of 21 feet 6 inches and a draft of 8 feet. Two Winton Diesel engines, of 250 horsepower each, will drive the yacht at a speed of 13½ knots.

### Six Steel Cargo Box Boats Ordered

A CONTRACT for the construction of six additional steel cargo box barges was recently awarded to the American Bridge Company, Ambridge, Pa., by the Union Barge Line Corporation, Pittsburgh, Pa. The price involved was not made public.



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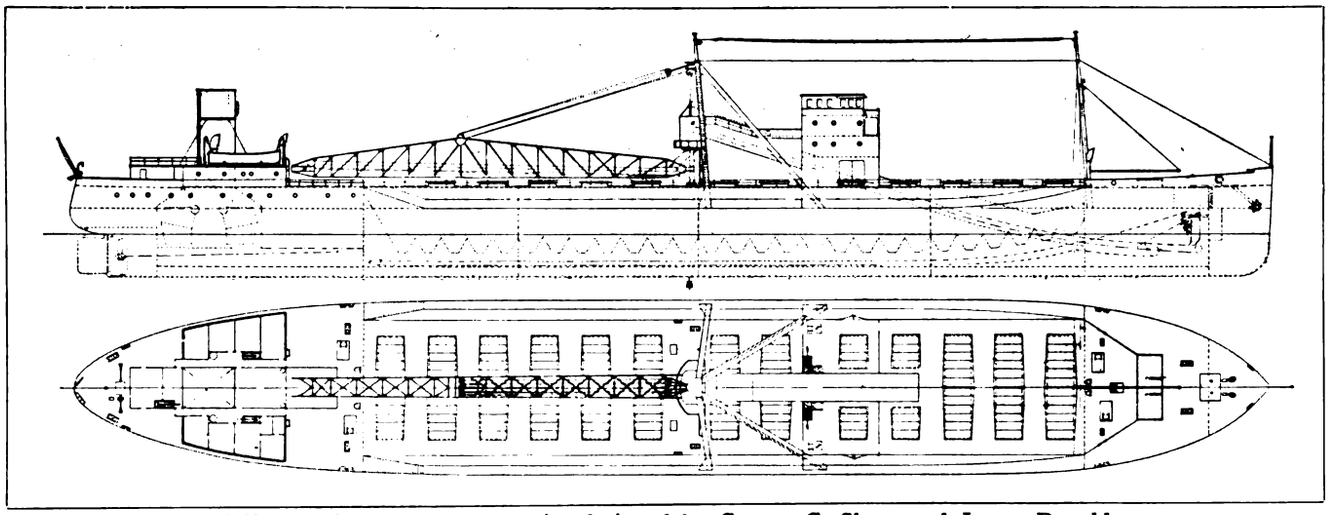

Self-unloading bulk cargo carrier designed by George G. Sharp and James Donald

## Plans Issued for Pan-American Industrial Corp. Vessel

PLANS and specifications for the construction of a self-unloading bulk-cargo vessel for the Pan-American Industrial Corporation, Buenos Aires, have been issued from the offices of George G. Sharp, in association with James Donald, naval architects and marine engineers, 30 Church street, New York city.

The vessel will have a length of 450 feet, a breadth of 68 feet, a depth of 35 feet and a deadweight carrying capacity of 9000 tons. Cargo will be carried in four holds, having hoppers in the bottom. When unloading the vessel, these hoppers will discharge into two hold conveyors, which in turn will discharge into a center conveyor forward which will carry the cargo to a point well above deck in the "A" frame. The cargo will then be discharged through a chute to a swinging boom, which will convey the material ashore. Cargo will be unloaded at a rate of 2,000 tons per hour. The holds may be emptied in about four hours.

The design calls for a single-screw vessel, driven by geared turbines. Steam will be supplied by three horizontal water-tube boilers, operated at a pressure of 225 pounds and a superheat of 100 degrees. Oil fuel will be used. Conveyors and deck machinery will be operated by electricity, developed by turbo-generators.

## Contracts for Constructing Survey Ship Hydrographer Awarded

CONTRACTS for the construction of the hull, main engine, and auxiliaries have been awarded by the United States Coast & Geodetic Survey, Washington, D. C., for the single-screw, Diesel-electric propelled survey ship *Hydrographer*. The contract for building the steel hull was awarded to Spear Engineers, Norfolk, Va., at a price of $213,000 on July 12.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., was recently awarded a contract for the electrical propelling equipment for this vessel.

Power for propulsion will be supplied by two engine-generator units. Each unit will consist of a single-acting, four-cycle Winton Diesel engine, developing 450 horsepower at 250 revolutions per minute, directly connected to a generator and a generator exciter. The main generators are shunt-wound, separately excited, 250-volt machines of 270 kilowatts capacity each. The generator exciters are compound-wound, self-excited, 125-volt machines of 25 kilowatts capacity each.

### Hull Details

The *Hydrographer* will have a length overall, 167 feet 5 inches, beam, molded, 31 feet 6 inches, and a draft of 9 feet 6 inches forward and 11 feet 6 inches aft. The displacement will be approximately 740 tons and the designed speed will be 12½ knots.

## Monticello and Mount Vernon Conditioning Bids to be Opened Oct. 2

THE date for the receipt of bids for reconditioning the liners *Monticello* and *Mount Vernon* has been extended from August 28 to October 2, in order that the various shipyards may be given more time to work on the plans and specifications, which were released a short time ago by Captain R. D. Gatewood, manager of the Shipping Board's maintenance and repair division, 45 Broadway, New York.

### To Be Added to United States Lines

The change of time is in line with the Shipping Board's decision to defer opening the bids for the sale of the United States and the American Merchant Lines from October 1 to November 15, because it was not possible to have the specifications covering the sales of these lines ready until August 15. Prospective purchasers will thus be given 90 days in which to consider their offers. The *Mount Vernon* and the *Monticello* will be added to the fleet of the United States Lines when conditioned for service.

According to the plans prepared by Gibbs Brothers, 1 Broadway, New York, for reconditioning the vessels, four alternatives will be made in addition to the original proposal, and according to the plans prepared by the Newport News Shipbuilding & Drydock Company, Newport News, Va., two alternatives will be considered.

## Floating Coast Guard Station Contract Awarded

THE United States Coast Guard Commandant, Darby building, Washington, D. C., has awarded a contract for the construction of one steel floating Coast Guard station for Louisville, Ky., to the Dubuque Boat & Boiler Works, Dubuque, Ia., at a price of $29,875. Bids for the work were received at Washington on August 2.

The station is to have a length overall of 90 feet 4 inches; beam, molded, 38 feet, and displacement at 2 feet 9 inches mean draft, with 12 tons of coal and one ton of stores, about 200 tons.

## Plans for New Colombian Line Vessels Held Up

CONTRARY to a previous report that plans and specifications for the construction of three vessels for the Colombian Steamship Company, Inc., 17 Battery place, New York city, were sent out to prospective bidders, it is learned that plans are held up in the offices of Theodore E. Ferris, naval architect, 30 Church street, New York city, pending completion. It is expected that these plans will be issued to the various yards shortly after Labor Day.

The vessels are to have a length overall of 402 feet 9 inches; a length between perpendiculars of 385 feet; beam of 54 feet 6 inches; depth of 31 feet 6 inches; draft of 24 feet, and a deadweight carrying capacity of 4000 tons. Each vessel will carry about 200 passengers of first and tourist class.

The ships will be propelled by single screws, driven by geared turbines. Steam will be supplied at 300 pounds pressure and 200 degrees superheat by four high-pressure watertube boilers. Oil will be used for fuel.

## Contract for Two Steel Barges Awarded to Howard Shipyard

THE United States Engineer Office, New Orleans, La., has awarded a contract for the construction of two 120-foot by 7-foot by 30-foot steel barges to the Howard Shipyards & Dock Company, Jeffersonville, Ind., at a price of $21,750 and a time of 75 days.

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### Plans for Two Freighters and a Schooner Under Way

IT has been learned that Burgess & Morgan, 11 Broadway, New York city, are designing two 250-foot freighters for operation on the Bee Line between Boston and Brooklyn.

Plans are also being prepared for one steel schooner. The schooner is to have a length of 160 feet and will be equipped with auxiliary engines.

### Plans for Thirty-five Steel Barges To Be Issued Soon

THE United States Engineer Office, Memphis, Tenn., will shortly be in the market for the construction of 32 or 35 steel barges. Plans and specifications for these barges will be issued within the next week or ten days. Further information will be available at a later date.

### Bids for N. Y. State Ferryboat Machinery to be Opened Sept. 12

THE date for the receipt of bids for furnishing machinery for installation in the two 115-foot Diesel-electric ferryboats for the Manhattan State Hospital, Ward's Island, N. Y., was postponed from August 15 to September 12. These tenders will be opened at the offices of Lewis M. Farrington, secretary of the Department of Mental Hygiene, Albany, N. Y.

### Plans for Building 13,000 Ton Tanker Definitely Abandoned

INFORMATION has been received at this office that plans for the construction of one 13,000 ton Diesel-electric tanker for the Standard Oil Company of California have been definitely abandoned. Bids for this construction were received on January 31 at which time the Newport News Shipbuilding and Drydock Company was low bidder with a price of $1,625,000.

### Bids for Construction of One Steel Dredge Hull

T. F. FARRELL, commissioner of Canals and Waterways, Department of Public Works, Syracuse, N. Y., opened bids August 30 for the construction of one steel hull for the dredge *St. Johnsville*. The hull is to have a length of 100 feet; breadth of hull, 34 feet; breadth overall of 41 feet; depth of 7 feet, and an estimated weight of 225 tons.

### Tenders for Propeller Shafts

SEALED proposals were received until 11:00 A.M., August 30, by the United States Engineer Office, First District, 401 Custom House, San Francisco, Cal., for furnishing propeller shafts for the United States dredges *A. Mackenzie* and *San Pablo*.

## Construction and Repair Bids

### Bids Received for Installation of Diesel Engines on Eight Shipping Board Vessels

CAPTAIN R. D. Gatewood, manager of the maintenance and repair division of the United States Shipping Board, 45 Broadway, New York city, opened tenders on Tuesday, August 21, for the installation of main Diesel engines and other work on the eight vessels—*Galveston, Oldham, City of Elwood, Ward, New Orleans, Wichita, Jeff Davis* and *Potter*.

The lowest proposal was from the Maryland Drydock Company, Baltimore, Md., who offered to recondition "any two vessels" for $1,064,368. Other bids were as follows:

Bethlehem Shipbuilding Corporation, Ltd., New York city: Any two vessels, $1,347,000; *Galveston* and *Oldham*, $1,287,000; *City of Elwood* and *Ward*, $1,333,000; *New Orleans* and *Wichita*, $1,347,000; *Jeff Davis* and *Potter*, $1,335,000.

Federal Shipbuilding Company, Kearney, N. J.; *Galveston* and *Oldham*, $1,258,000; *Jeff Davis* and *Potter*, $1,258,000; *City of Elwood* and *Ward*, $1,350,000; *New Orleans* and *Wichita*, $1,354,000.

Morse Drydock & Repair Company, Brooklyn, N. Y.; *Jeff Davis* and *Potter* $1,202,940.

Newport News Shipbuilding & Drydock Company, Newport News, Va.: *City of Elwood* and *Ward*, $1,272,500.

Sun Shipbuilding & Drydock Company, Chester, Pa.; *Galveston* and *Oldham*, $1,336,800; *City of Elwood* and *Ward*, $1,320,200; *New Orleans* and *Wichita*, $1,329,600; *Jeff Davis* and *Potter*, $1,335,200.

Todd Shipyards Corporation, New York city: *Galveston, Oldham, Ward* and *City of Elwood*, $777,000 each; *New Orleans*, $757,000; *Wichita*, $756,000; *Jeff Davis* and *Potter*, $775,000 each.

Boston Navy Yard: *Galveston* and *Oldham*, $1,342,819; *City of Elwood* and *Ward*, $1,353,615; *New Orleans* and *Wichita*, $1,359,000; *Jeff Davis* and *Potter*, $1,344,536.

New York Navy Yard: Any two vessels, $1,831,200.

At the time the main bids were taken, the following bids for installing passenger space in the ships and supplying Oertz contra-rudders were received:

| Name | Cost for passenger space (2 Vessels) | Oertz Rudder 1 Rudder | Oertz Rudder 2 Rudders | Contra-Rudder 1 Rudder | Contra-Rudder 2 Rudders |
|---|---|---|---|---|---|
| Bethlehem S.B. Co. | $32.800 | $5,200 | $10,300 | $5,000 | $9,900 |
| Federal S.B. Co. | 25,000 | 4,000 | 7,900 | 4,800 | 9,200 |
| Maryland Drydock Co. | 18,710 | 5,580 | 11,080 | 6,800 | 13,500 |
| Morse Drydock & Repair Co. | 26,800 | 4,870 | 9,740 | 5,710 | 11,420 |
| Newport News S.B. & D.D. Co. | 28,000 | 4,500 | 8,800 | 4,700 | 9,200 |
| Sun S.B. & D.D. Co. | 27,500 | 5,877 | 11,754 | 7,620 | 15,240 |
| Todd Shipyards Corp. | 29,308 | 7,800 | 15,600 | 7,580 | 15,160 |
| Boston Navy Yard | 23,362 | 2,587 | 5,174 | 2,537 | 5.074 |
| New York Navy Yard | 41,200 | 3,100 | 6,200 | 2,900 | 5,800 |

All the vessels are of the Doullut and Williams type. After conversion their dimensions will be: Length overall, 411 feet 9 inches; length between perpendiculars, 395 feet 6 inches; beam, molded, 55 feet; depth, molded, at side to shelter deck, 34 feet 11 inches; normal mean load draft, 27 feet ¼ inch, and deadweight capacity about 9000 tons.

The bids have been forwarded to Admiral Cone, Shipping Board commissioner in charge of construction at Washington, D. C., and it is expected that he will make awards shortly. The entire fleet should be ready for service within a year of the time the contracts are awarded.

### City of Tacoma Fireboat Contract Awarded

A CONTRACT for the construction of a fireboat for the City of Tacoma, Wash., was recently awarded to the Coast Line Shipbuilding Company, Tacoma, Wash., by the Board of Contracts and Awards, at a price of $140,285 and a delivery time of nine months. The vessel will have a carrying capacity of 10,000 gallons, and a working pressure of 185 pounds.

### Burrard Drydock Co. Bids Low on Union Oil Tanker

BIDS for the construction of one small tanker for the Union Oil Company of California, Union Oil building, Los Angeles, Calif., were recently received from the Burrard Drydock, Company, Ltd., North Vancouver, B. C., Can.; Moore Drydock Company, Oakland, Calif., the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., and the Los Angeles Shipbuilding & Drydock Corp., San Pedro, Calif. The Burrard Drydock Company was low bidder for the work.

### Grace Line Opens Bids on Two Passenger and Freight Ships

BIDS were opened privately recently, covering the construction of two 16-knot passenger and freight ships for the Grace Line, Inc., 10 Hanover Square, New York city. The vessels will be practically duplicates of the motorship *Santa Maria*, which was placed in service early in the summer. The bids covered machinery similar in type to the *Santa Maria* and also alternative proposals on high-pressure, steam-driven propelling machinery.

#### Details of Santa Maria

The *Santa Maria* has a length overall of 486 feet, beam 64 feet and a gross tonnage of slightly over 9,000. The normal draft is 25 feet.

Consideration will be given to the alternative machinery proposals before any action is taken on the award of contracts.

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## Fletcher Co. Bids Low on S.S. El Cid Repairs

WITH a price of $29,920, the W. & A. Fletcher Company, Hoboken, N. J., submitted the lowest proposal covering repairs to the Southern Pacific Steamship Lines steamship *El Cid*. The *El Cid* is of 4,508 gross tons. Tenders for the work were received at New York on Tuesday, August 14, and five other bids were submitted as follows:

| Name | Price |
|---|---|
| Morse Drydock & Repair Company | $37,486 |
| James Shewan & Sons, Inc. | 37,974 |
| Robins Drydock & Repair Company | 38,496 |
| Tietjen & Lang Drydock Company | 41,852 |
| New York Harbor Drydock Company, Inc. | 42,824 |

A contract for the work has not as yet been awarded.

## Bids Received for S.S. Veramar Repairs

WITH a price of $25,276 and a time of 24 days, the Tietjen & Lang Drydock Company, Hoboken, N. J., submitted the lowest proposal covering repairs to the steamship *Veramar*, bids for which were received recently by Kindlund & Drake, marine engineers and naval architects, 17 Battery Place, New York city. Two others tenders were submitted as follows:

| Name | Price | Days |
|---|---|---|
| Morse Drydock & Repair Company. | $26,269 | 28 |
| New York Harbor Drydock Company, Inc. | 30,928 | 24 |

The award has not as yet been made.

## S.S. Gypsum Prince to be Repaired at Robins Yard

BIDS covering repairs to the *Gypsum Prince* of the Gypsum Packet Company, Ltd., 17 State street, New York city, were received recently. Plans and specifications for the work were prepared by Frank S. Martin & Son, naval architects, 25 Broadway, New York city. The ship, fully loaded, touched on a bar at Nova Scotia and was left high and dry. Some plates amidships for about 40 feet were badly buckled.

The contract for repairs was awarded to the Robins Drydock & Repair Company, Brooklyn, N. Y., at a price of $49,100 and a time of 30 days. Two other tenders were submitted as follows:

| Name | Price | Days |
|---|---|---|
| New York Harbor Drydock Company, Inc. | $64,520 | 35 |
| Morse Drydock & Repair Company | 68,000 | 35 |

## Morse Yard to Repair the S.S. Commercial Navigator

BIDS were recently received by the Moore & McCormack Company, Inc., 5 Broadway, N. Y., covering repairs to the steamship *Commercial Navigator*, and a contract for the work was awarded to the Morse Drydock & Repair Company, Brooklyn, N. Y., at a price of $9,079. Eight other tenders were received for the work as follows:

| Name | Price |
|---|---|
| W. & A. Fletcher Company | $ 9,600 |
| Tietjen & Lang Drydock Company | 12,064 |
| Staten Island Shipbuilding Company | 13,200 |
| Robins Drydock & Repair Company | 14,205 |
| James Shewan & Sons, Inc. | 15,236 |
| Atlantic Basin Iron Works Corporation | 15,275 |
| Sun Shipbuilding & Drydock Company | 15,635 |
| New York Harbor Drydock Company, Inc. | 15,994 |

# Great Lakes Notes

## New Record Established in Loading Bituminous Coal

A LOADING record of bituminous coal was made on July 9 at the B. and O. railway dock in Toledo, O., when the *Benson Ford* took on 254 cars of coal in 4 hours and 50 minutes, actual time.

The fastest record ever made at a Lake Erie dock was 53 cars an hour while in this record there were 62 cars dumped in one hour which makes a mark for future efforts to shoot at. The average of the *Ford* was 47.8 cars per hour.

## Detroit & Cleveland Navigation Company to Operate Airplane Service

THE Detroit & Cleveland Navigation Company plans to begin the operation of flying boats carrying 26 passengers between Detroit, Cleveland and Buffalo within a year, if satisfactory equipment can be procured.

According to A. A. Schantz, president of the steamship line, it is planned to use the German-made Dornier Super Wal flying boats in the service, and the company now has an engineer in Germany investigating the possibility of adapting these flying boats to the transportation of passengers between Great Lakes cities.

Mr. Schantz said that the Detroit & Cleveland Aerial Navigation Company, a subsidiary of the D. & C. Navigation Company, was organized eighteen years ago with a view to operating such a service when suitable equipment should be prepared to accept transportation by air.

The Dornier Super Wal is a four-motored flying boat carrying 26 passengers and a crew of four—pilot, mechanic, radio operator and navigator—at a speed of 100 to 150 miles an hour. The passengers and crew are carried in the hull, which is constructed of metal with a double bottom and airtight compartments. These flying boats take off and alight on water and are intended for operation over that medium. Several Super Wals are now in use on Germany's commercial air lines.

## Repair Work at Great Lakes Yards

THE lake freighter *Kiowa*, which was recently drydocked at the Lorain yards of the American Shipbuilding Company, has 33 damaged plates which must be removed. The vessel went ashore at Parisenne Island.

The steamship *A. H. Ferbert* was recently in collision with the freighter *Mantadoc* in the St. Clair river. Three plates were ripped from the *Ferbert*. The *Mantadoc*, loaded with grain, was also considerably damaged and was sent to the River Rouge yards for repairs.

Repairs to the steamship *A. W. Osborne* were recently completed at the Lorain yard of the American Shipbuilding Company.

The freighter *W. A. Hazard* was struck by the steamship *Sinaloa* at a Detroit dock. The *Hazard* was placed on the ways for examination and repairs.

The steamship *Coralia* was recently docked at the River Rouge yards for repairs.

The steamship *Philip Minch*, which was damaged at Lucille Island recently, was sent to Port Arthur for temporary repairs.

## Bids for Two Ships for Di Giorgio Fruit Company Received in August

BIDS were privately opened in the offices of the Di Giorgio Fruit Company, 25 Broadway, New York, for the construction of one and two ships, respectively, on Wednesday, August 1. The vessels are for operation between the United States and West Indies ports. No information has as yet become available on the action to be taken by the company.

## Union Barge Line Awards Contracts for Eighteen Barges

THE Union Barge Line Corporation, Wabash building, Pittsburgh, Pa., has placed contracts for the construction of 18 barges. The new vessels are to be 175 feet long, 26 feet wide and 11 feet deep. Nine of the barges will be built by the American Bridge Company, Ambridge, Pa., and nine by the Dravo Contracting Company, Pittsburgh, Pa. The approximate price involved is $250,000.

## The Brooklyn Polytechnic Institute Offers Diesel Engine Course

THE Polytechnic Institute of Brooklyn, N. Y., has announced an evening course in Diesel engines to be given in 20 two-hour lectures during the coming winter. Beginning with the last Tuesday in September, these lectures will be given each Tuesday evening at 7:30. The lecture course may be supplemented by classroom exercises and laboratory periods, at which time several types of oil engines will be available for demonstration and testing. The laboratory and classroom periods will be held on each alternate Monday evening.

It is planned to cover oil-engine design, construction and operation in far greater detail than is necessary for passing the examinations for certificates to operate motor vessels under the Steamboat Inspection Service.

The subjects to be treated are combustion; solid and air injection; two-stroke and four-stroke cycles; fuel pumps; bedplates and framing; cylinders, cylinder heads, pistons, bearings, valves and valve gears; starting and reversing systems; lubricating and cooling systems; selection of fuel and lubricating oils; installation, alinement, fitting, overhauling and adjusting; and cost data.

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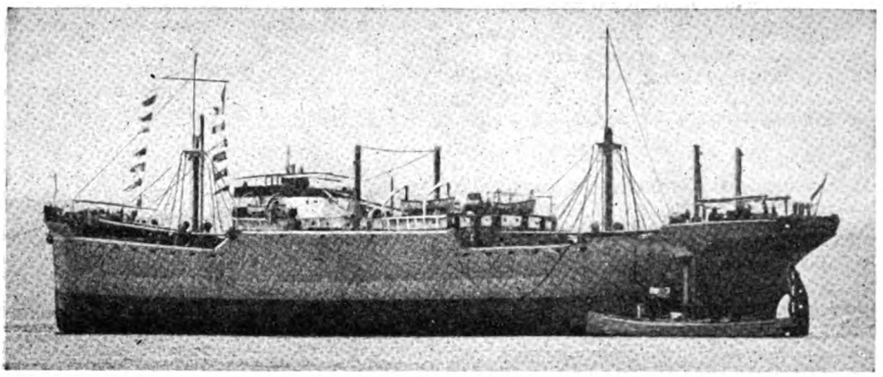

The Watford after taking the water

## Steamship Watford Launched

THE steamship *Watford,* built by the general cargo trade of Watts, Watts & Company, Ltd., London, managing owners for the Britain Steamship Company, Ltd., was recently launched at the yard of the Caledon Shipbuilding & Engineering Company, Ltd., Dundee, Scotland.

The *Watford* is about 405 feet long, and has a capacity of about 9000 tons deadweight on 24 feet 6 inches draft. She is one of the largest single-deck steamships afloat and the holds are exceptionally clear of obstructions. The deck machinery includes 11 steam winches and a general outfit of five-ton derricks. One special derrick is provided for handling loads up to 50 tons. The topmasts are of the sailing-ship type and can be lowered to the level of the top of the funnel when necessary for bridge clearance.

The machinery, to be installed by the North-Eastern Marine Engineering Company, Ltd., Wallsend, England, will consist of triple-expansion engines, 25 inches by 42 inches by 70 inches in diameter, with a stroke of 48 inches. Steam will be supplied at a pressure of 185 pounds per square inch, by three single-ended Scotch boilers, 16 feet in diameter and 11 feet 6 inches long. The funnel is divided into three chambers, so that the uptake from each boiler is independent. This arrangement is intended to avoid back draft and also to allow the use of any one of the three boilers without varying the draft.

The vessel is expected to make 10¼ knots on 30 tons of coal per day. Two other ships of the same type are also being built in the same yard.

## German Liners Bremen and Europa Launched

THE new North German Lloyd liners *Bremen* and *Europa* were recently launched at the Blohm & Voss shipyard, Hamburg, Germany. The vessels are 937 feet long with a gross tonnage of 46,500 and a speed of 25.5 to 27.5 knots.

One of the unusual exterior features of these new transatlantic vessels will be wide and unobstructed upper deck areas, providing space not only for outdoor sports, but more than ample room for the landing and taking-off of airplanes, which may form a regular part of the liners' service and equipment. By this method it is hoped to cut down the schedule time for the mails between New York and Europe by one day at least. The vessels will make the trip from Bremen to New York in six days and from Channel points in five days.

Preliminary estimates placed the cost of the new ships at about $11,500,000 each, but it is believed that the actual cost is considerably higher.

## International Life-Boat Races to be Held September 3

AT a meeting of the executive committee of the Neptune Association held recently at 82 Broad Street, New York city, William H. Todd was elected chairman of the committee in charge of the International Life-Boat Races which will be held on Labor Day. Last year Mr. Todd contributed the William H. Todd International Life-Boat Racing Trophy, which is to go to the company who first succeeds in winning the life-boat race three times. Last year it was won by the firm of Garcia and Diaz, New York city.

The other members elected to this committee are Vincent Astor, who was chairman last year, Colonel E. F. Albee, Captain Hilmer Anderson, Commander Richard E. Byrd, Commodore H. A. Cunningham, Captain Hubbard C. Fish, Captain R. M. French, Captain George Fried, Commodore Herbert Hartley, Lawrence Kaine, Captain C. A. McAllister, Captain E. F. Mitchell, Captain Sam Reynard, Captain Jake Rickert and Captain Theodore van Beek.

With the experience gained in the races last year, the rules which have been laid down this year practically assure every starter of a fair chance to win. In this year's race every boat will pull the same weight through the water.

## Marine Section of National Safety Council Announces Program for Annual Congress

THE 17th annual safety congress of the National Safety Council will be held in New York city, October 1 to 5, inclusive. It is anticipated that more than 5000 delegates from all parts of the United States and foreign countries will be in attendance and over 270 speakers are on the program.

The Marine Section of the National Safety Council, composed of nearly 200 of the leading American steamship owners and operators, shipyards, stevedoring companies and affiliated organizations, will hold its meeting apart from the general council and will have its headquarters at the Waldorf Astoria Hotel, 5th avenue and 34th street, New York city.

On Monday, October 1, the general session of the National Safety Council will be held in the grand ballroom of the Hotel Pennsylvania, at 9:30 A. M., at which time an address by Homer L. Ferguson, president of the Newport News Shipbuilding & Drydock Company, Newport News, Va., will be given. At noon, a combined luncheon meeting of the Marine Section and of the Propeller Club of the Port of New York will be held at the Waldorf Astoria.

Tuesday, October 2, will be known as "New York Maritime Exchange Day" and the meeting of the Marine Section will open at the Waldorf Astoria at 9:30 A. M. John Dowd, president of the New York Maritime Exchange, will give the opening address. Four other addresses will be given as follows:

"The Human Equation in Safety" by Dickerson N. Hoover, supervising inspector general, United States Steamboat Inspection Service, Washington, D. C.

"Medicine in Industry" by Francis X. Crawford, M. D., port medical officer, United Fruit Company, Boston, Mass.

"Making the Safety Movement Attractive to the Personnel" by Henry Herbermann, president of the Export Steamship Corporation, New York city.

"Sounding Devices to Promote Safety on the Surface of the Seas" by H. J. W. Fay, vice-president of the Submarine Signal Corporation, Boston, Mass.

The American Steamship Owners' Association will hold its meeting in conjunction with the Marine Section on Wednesday, October 3, at which time H. B. Walker, president of the American Steamship Owners' Association, New York city, will speak on "Safety in the American Merchant Marine." "Safety Practices for the Prevention of Accidents in Stevedoring" is the subject of an address to be given by Joseph J. Farrell, Travelers' Insurance Company, New York city.

"Safety in Gage Glasses—Their Use and Abuse," is the subject to be discussed by William A. Tucker, manager of the Moncrieff-Rogers Division, Jenkins Brothers, New York city.

"The Relation of Classification to Safety of Ships" is the subject of an address by Captain Charles A. McAllister, president of the American Bureau of Shipping, New York city. Following Captain McAllister's paper, the annual election of officers will be held.

On Thursday, October 4, the Marine Section will meet at the Waldorf Astoria at 9:30 A. M., in conjunction with the National Board of Steam Navigation, at which time the following addresses will be given:

"The Importance of the Human Element" by Arthur J. Grymes, president of the National Board of Steam Navigation.

"Taking Steps to Insure the Safety of Passengers at Sea" by David A. Burke, general manager of the United States Lines, New York city.

"Marine Accidents—Their Cause and Remedies" by Captain Reginald Fay, marine superintendent of the New York Central Railroad Company, New York city.

"Activities of the United States Coast Guard in Saving Life and Property" by Commander W. F. Towle, United States Coast Guard, New York city.

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**Institution of Engineers and Shipbuilders in Scotland,** 39 Elmbank Crescent, Glasgow.

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**North East Coast Institution of Engineers and Shipbuilders.** Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

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# Marine Engineering and Shipping Age


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*The Exide-Ironclad Battery stores up surplus current . . . uses it to smooth out fluctuating loads in winch operation*

*Exide-Ironclad Batteries increase the efficiency of oil auxiliary engines on motorships. They smooth out fluctuating loads in winch operation.*

TO utilize spare power—smooth out fluctuating loads in winch operation—that is one way an Exide-Ironclad Battery can increase the efficiency of your auxiliary engines.

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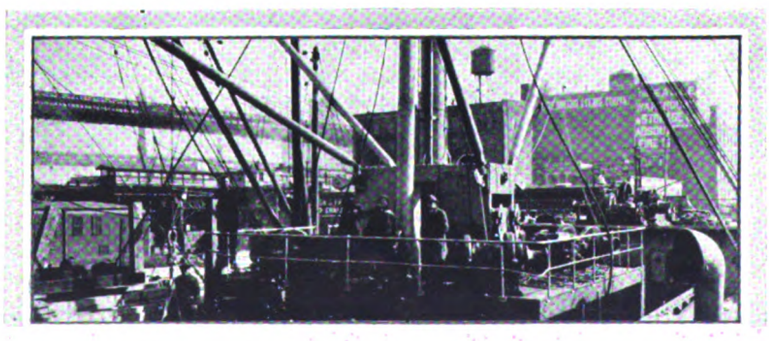

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY. Philadelphia

*Exide Batteries of Canada, Limited, Toronto*


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# Marine Engineering
## and Shipping Age

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## Shipbuilding Prospects

THAT the promise of a considerable amount of new work for the shipyards, which was held out earlier this year by the passage of the Jones-White bill, will soon be fulfilled is shown by the fact that plans and specifications for 20 new vessels have already been completed while the designs of 22 additional vessels are in the process of development, some of which are nearing completion so that they will soon be ready for submission to the shipyards for bids. All of this preliminary work can be looked upon as the beginning of a new period of activity in the shipbuilding industry, which is likely to continue for some time to come. Considerable time has necessarily elapsed before any actual construction could be started in order to enable the shipowners to comply with the beneficial provisions of the bill. This delay, in view of the size and importance of the proposals under consideration, was to be expected. Progress is being made, however, in the award of mail contracts and several applications have been received by the Shipping Board for loans for the construction of new vessels while a number of other shipowners are negotiating for loans. Keen competition in bidding for the new contracts will naturally follow but shipowners must realize that the cost of building the type of vessels designed to meet the requirements of the new legislation cannot be measured by the costs of the slower cargo vessels with which they are more familiar. For this reason we recommend a careful study of the statements of the National Council of American Shipbuilders, published elsewhere in this issue, regarding the status of shipbuilding prices and the effect of the speed of a vessel upon its cost of construction.

## French Shipbuilding

FOR some time the shipbuilders in France have been in the depths of despair over the lack of new business. To remedy the situation, the French government enacted on July 6 a bill providing for the establishment of the Credit Maritime. This is the first step looking toward the encouragement of shipbuilding that has been taken by the French Government since 1906, but so far there is little prospect that the shipbuilders will receive any material benefit from the new law. In accordance with the new scheme the Credit Foncier, a bank specializing in mortgages and loans, is authorized to lend to French shipowners sums totaling 200,000,000 francs a year during a period of 5 years. The loans are to be refunded within 20 years and the rate of interest at present is about 9 percent, one-half of which is to be paid by the shipowners and the other half by the State. It is generally believed that this scheme, however well meant, will be of little help to either the shipowners or the shipbuilders for two reasons; first, because the rate of interest is high, and, second, because French shipowners are authorized to place orders abroad when foreign quotations are 15 percent lower than French prices. Since the new law went into effect several important orders have been placed with a British yard and one of the large French shipyards is going into liquidation.

## The United States Lines

IN the past few years, this paper has, a number of times, taken the occasion to remark upon the very excellent service rendered by the United States Lines. It is quite safe to say that nowhere are better meals served or more careful and courteous attention given to meeting and anticipating the requirements of the most exacting traveler than on the *Leviathan* and that the character of service rendered by the other and smaller vessels of the line will bear the most searching



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comparison with any foreign vessels of their class. The line has become, in a sense, a national institution, it has established a "good will" of great value and its future is a matter of very material interest to the whole country.

It has long been known to operators of transatlantic passenger tonnage, and the fact is now recognized by those less familiar with this particular division of the shipping business, that if the United States Lines is to continue in business as a competitive and "going" concern it will have to acquire new and modern tonnage in the very near future.

There does not appear to be any great likelihood that the Government itself will undertake the construction of large passenger liners; the present administration is clearly in favor of the policy of "getting the Government out of shipping" in the shortest possible time and in line with this the United States Lines is now offered for sale to private parties.

If the line is to hold its present position in the face of the competition of the new ships which are rapidly making their appearance in the foreign-flag lines, it will need, at once, two large vessels to run with the *Leviathan*—vessels offering accommodations and service at least equal to what is now to be found on that ship. Two such vessels would probably cost in the neighborhood of $30,000,000. Three-quarters of this amount, or $22,500,000, could be borrowed from the Government at perhaps 3 percent, while the remainder would have to be furnished by the new owners of the line at a cost of 6 percent, thus making a total interest charge of $1,125,000. Depreciation and insurance added to the interest on the money invested would give a total carrying charge in the neighborhood of $3,500,000 per year on the two ships or approximately $1,250,000 on each vessel.

The *Leviathan* is reported to have earned a gross profit of $500,000 per year, which means, presumably, that the income from her operation exceeds the operating charges by this amount, no account being taken of interest, depreciation and insurance. If this assumption is correct, each of the new ships would have to earn $750,000 a year in excess of what is now turned in by the *Leviathan* in order to break even. Undoubtedly new vessels would be more economical to operate and certain other savings could probably be realized from private as against government operation. It looks like a "pretty close fit" but an experienced and well-organized steamship line with sufficient financial backing to carry it over the slack seasons which are bound to occur would at least have a fair fighting chance of success.

To give up the only American transatlantic passenger line, particularly in view of the excellent reputation which it has succeeded in establishing, would be little short of a national calamity. It is sincerely to be hoped that one of our experienced operating companies may see its way clear to undertake the carrying on of the line.

# Demands on Material by the Modern Steam Plant

THE tendency in steam engineering, both afloat and ashore, has been steadily toward higher pressures. Until the advent of the turbine, the most obvious and indeed the only practical method of materially increasing the economy of the engine was by increasing pressure, thus taking advantage, to the greatest possible extent, of the expansive property of steam. As the lower end of the scale was limited by the inability of the reciprocating engine to profit fully by high vacuum, the range of expansion could be extended only by higher initial pressure. The degree of expansion which could be handled economically by a single cylinder or simple engine being reached, the compound engine made its appearance, and this, following the line of development so clearly indicated, was soon superseded by the triple expansion engine. Here, so far as type of engine was concerned, progress paused. Some quadruple engines were, and still are, built, but the actual net gain with each of these successive modifications of type is relatively less, greater mechanical complexity and increased first cost tending to offset the undoubted thermodynamic gain resulting from higher pressures and correspondingly greater ratios of expansion.

The turbine made possible the utilization of the lower part of the expansion curve, material increase in economy being thus obtained without further increase of initial pressure but, on the other hand, its introduction led to a greater use of superheat.

The increment in pressure as between the simple engines of perhaps 50 years ago and the modern triple, quadruple or turbine, while accompanied by a considerable rise in the temperature of the steam, has not been such as to affect very materially the physical qualities of the iron, steel and other metals with which the steam comes in contact. It is true that increasing pressure, coupled with the ever-present necessity of keeping the weight of marine engines within reasonable bounds has tended toward larger unit stresses and has made strength and uniformity of quality most essential characteristics of both boiler and engine materials but the maximum steam temperature in the vast majority of marine steam plants is not yet sufficient to cause a material change in the properties of iron and steel as indicated by the ordinary physical tests.

Higher pressures than are ever found on shipboard have for some time been used in certain shore power stations and, through the use of superheaters, temperatures which are relatively even higher are not uncommon in these stationary plants. While it is fair to presume that the ordinary "advancement of the art" would eventually have brought about similar developments in marine plants, it is the injection into the problem of ship propulsion of an entirely new and hitherto outside factor which has brought marine engineers face to face

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with the necessity for higher pressures and temperatures and their attendant difficulties.

It is becoming increasingly evident to every broad-minded marine engineer that if the steam engine, either reciprocating or turbine, is not to be superseded by internal-combustion machinery in many of the various services in which it is now employed, its economy of operation will have to be materially increased above the average which at present obtains. Furthermore, it appears equally apparent that this increase in efficiency must come as the result, in large part, of higher steam temperatures.

The temperatures corresponding to the pressures in general use in marine plants for the past decade range from 375 to 400 degrees F. While these temperatures have made necessary special provisions for lubrication and for the composition of such lubricants as come into direct contact with the steam, and also have led to the development of improved types of rod and piston packing, etc., they are not sufficient to produce any appreciable change in the molecular structure of iron and steel. During this same period, superheat has been adopted but in more or less isolated cases and in general to what, in view of present proposals, appears a very limited extent.

In the past five or six years, Diesel competition has put a very different face on the whole matter, higher pressures and temperatures evidently must come if steam propulsion is to continue in general use in ships and a most pressing question with marine engineers is the determination of the practical limits of this development. Really this question seems to resolve itself into two parts—what is the limiting increase in pressure above present practice from which appreciable gain may be looked for and what limit may be placed upon increasing temperatures by their prejudicial effect upon those metals which it appears commercially possible to make use of in the construction of steam machinery.

At least a partial answer to these questions is found in the report of the investigations of Professors Mellanby and Kerr of Great Britain. In the matter of pressure these gentlemen are of the opinion that the upper limit of pressure, beyond which any real gain in economy will be relatively small, is in the neighborhood of 1250 pounds per square inch. While the temperature corresponding to this pressure may not be sufficient to affect iron and steel very seriously, the enormous stresses set up by the pressure alone make necessary the use of very special material such as forged boiler drums, valve bodies, pipe fittings and flanges. It should be noted, however, that in a large plant the higher pressure, coupled with superheat, may reduce the number of boilers required and thus offset the additional cost of these special materials.

As regards the limit of temperature, Messrs. Mellanby and Kerr consider that the limit set by materials at present in use, even allowing for probable improvements in their quality, is approximately 900 degrees F.

Taking 900 degrees as a temperature which may have to be dealt with in the near future as a result of the increasing use of the superheater, it is of interest to note what effect it has, or may have, on the materials now generally used. It is known that ordinary mild steel boiler tube material, having a tensile strength of 50,000 to 55,000 pounds per square inch when tested at ordinary temperature, suffers when the test temperature is raised to around 900 degrees, the tensile strength being reduced to about 45,000 pounds per square inch. So far as the tests indicate, it would appear that this temperature does not reduce ultimate strength to the danger point but recent investigations show that, if high temperature and load continue to act for a considerable period of time, a creeping or flow of the metal takes place, which will eventually cause failure at a stress much lower than the ultimate strength as determined by ordinary methods of testing. It has also been found that there is a limiting stress corresponding to a given temperature, known as the limiting creep stress, below which creeping and consequent failure will take place.

The investigations of the effects of high temperatures upon boiler steel have not yet advanced to such a point as to be entirely conclusive, but they clearly indicate tendencies. Elsewhere in this issue will be found a reprint of a most interesting article which recently appeared in the *Liverpool Journal of Commerce*, giving a very clear idea of the present state of available knowledge on this subject.

It would appear that for the power house engineer, concerned, as he now is in many instances, with pressures well above 1000 pounds per square inch coupled with superheat, the question of temperature effect upon metals is a most pressing one. So far, the marine engineer is less concerned, for it does not now seem probable that such excessive pressures and temperatures will come into general use on shipboard, at any rate not in the near future. It is, however, quite probable that pressures as high as 500 pounds per square inch and steam temperatures of from 700 to 800 degrees F. will come into more or less general use. While these do not closely approach the conditions described in the article above referred to, they are sufficiently onerous to make necessary the very greatest care, both as to materials and workmanship, in the construction of boilers, piping and machinery which will have to withstand them.

The accident which occurred last fall on the high-pressure steamer *King George V* makes only too clear the amount of care necessary to the successful operation of high-pressure machinery on board ship. While this particular accident was not due to defective boiler material, but to scale formation and consequent overheating, the detail report of the accident gives a rather impressive picture of material subjected to most trying operative conditions.

Higher pressures and temperatures are "due" on shipboard and will undoubtedly make their appearance in increasing numbers of vessels, but their successful adoption is not the simple and easy matter which some engineers would have one believe.

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## Business and Personal

**Paul Mackall** has been appointed vice-president of the **Bethlehem Steel Corporation,** Bethlehem, Pa., in charge of general sales, succeeding **E. S. Kinsley,** who has retired to less active duties.

**Ross H. McMaster,** president of the **Steel Company of Canada,** has been appointed a director of the **Canada Steamship Lines, Ltd.,** 9 Victoria Square, Montreal, Que., Can.

The **Apollo Metal Works** of LaSalle, Ill., has announced that its laboratories have originated a process of manufacturing chromium plate that has been converted into commercial form and is offered as Apollo Chrome.

**A. J. Morris,** well-known steamship agent and freight broker, has been appointed New York representative of the export and import bureau of the **Baltimore Association of Commerce,** with offices at 8 Broadway, New York city.

**J. Munroe Holland,** president of the **Chesapeake Bank of Baltimore,** has been appointed a vice-president of the **Hudson River Night Line,** Pier 32, N. R., New York city. He was also appointed a member of the executive committee, succeeding the late **J. H. Fleming,** former state comptroller and mayor of Troy, N. Y.

**J. Thos. Rhamstine,** manufacturer of electrical apparatus, Detroit, Mich., has taken over the business of the **American Strombos Company** and will manufacture all types of Strombos horns. This company controls the patents on air diaphragm horns in the United States and anticipates expanding the field on these units and adding various types to the line from time to time.

The **Ira J. Owen Organization,** industrial engineers, with offices at 400 First National Bank Building, Chicago, Ill., has entered the field of industrial engineering. Mr. Owen, who heads the organization, is a graduate of **Cornell University,** a member of the **American Society of Mechanical Engineers,** and has had 25 years practical experience in analyzing, reorganizing and operating industrial and commercial plants.

**Alfred V. de Forest,** research engineer for the **American Chain Company,** Chicago, Ill., was recently honored by the **National Society for Testing Materials,** which organization awarded him the Dudley National Medal in recognition of his achievement in perfecting a non-destructive test for materials. With this device it is now practical by means of a graph on which appears a hysteresis loop, to determine instantly whether or not the material under examination has the slightest defect.

**George M. Marr,** formerly with **Chas. Cory & Son, Inc.,** New York city, and most recently the marine sales manager for that corporation, New York city, has resigned from that concern to accept a position with the **Fyre-Freez Corporation** as director of engineering and sales, department of fire protection systems. In his new position, Mr. Marr will devote most of his time to the sale and installation of systems of smoke detection for cargo holds, heat detection for passenger quarters, in combination with the newly developed Fyre-Freez $CO_2$ extinguishing systems.

## Trade Publications

SMOOTH-ON.—The Smooth-On Manufacturing Company, Jersey City, N. J., has published a small condensed edition of a handbook entitled "Helpful Ideas for Engineers." This booklet does not replace the original large reference edition, but contains a description of the wide variety of conditions under which smooth-on can be successfully applied.

GAS RANGES.—The Stamford Foundry Company of Stamford, Conn., has issued a catalogue describing Shipmate gas ranges and Shipmate gas. These ranges may be used on yachts and small vessels and are capable of doing all sorts of cooking, including baking and broiling. The fuel, a non-poisonous gas, is contained in steel cylinders which are easily stored.

ELECTRIC OVENS.—The Edison Electric Appliance Company, Inc., Chicago, Ill., has issued a catalogue and price list covering a new electric oven, known as the AD-A-Deck sectional type oven. These utility ovens occupy a very small amount of floor area, yet are capable of a large hourly production. Their cost of operation compares favorably with that of the commercial electric toaster.

LUBRICATION.—The Vacuum Oil Company, 61 Broadway, New York city, has published an annual booklet entitled "Correct Lubrication for Motorboat Engines," which explains the methods of securing better gasoline engine performance. Motorboat engines, outboard motors, and Diesel engines are dealt with in regard to the selection of oils for lubrication.

SOOT BLOWERS.—"Increasing Marine Profits" is the title of a new 40-page bulletin just published by the Diamond Power Specialty Corporation, Detroit, Mich. A description of Diamond soot blowers as applied with coal, pulverized fuel, and oil firing is given. The application to Scotch and watertube boilers of all types, superheaters, air heaters, and economizers for both merchant marine and naval use is explained in detail.

DIESEL ENGINES.—Busch-Sulzer Bros.—Diesel Engine Company, St. Louis, Mo., has issued a pamphlet describing the type E two-cycle Diesel engine manufactured by that concern. The type E Diesel engine has been developed without essential modification from the Busch-Sulzer 2-cycle design but, because of its somewhat higher rotative speed, requires small space and is well suited for direct or electric drive of small vessels, for electric drive of large vessels, for auxiliary use in motor and sailing ships, and for stand-by and auxiliary service in land plants.

## Marine Societies

### America

**American Marine Association,** 30 Church St., New York. President—Col. E. A. Simmons.

**American Marine Standards Committee.** Chairman, Colonel E. A. Simmons. Secretary, A.V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

**American Society of Marine Designers.** Secretary.—B. G. Barnes, 202 Kendrick Ave. Quincy, Mass.

**American Society of Marine Engineers.** 605 Market St., San Francisco, Calif. President—Henry F. Gelhaus. Secretary—W. H. Thille.

**American Society of Naval Engineers.** Navy Department, Washington, D. C. Secretary Treasurer & Commander H. B. Hird, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

**American Steamship Owners' Association,** 11 Broadway, New York. President—H. B. Walker.

**Atlantic Coast Shipbuilders' Association.** 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

**Council of American Shipbuilders, Inc.,** 50 Broadway, New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

**Jersey Marine Club,** 4th and River Streets, Hoboken, N. J. Secretary—Fred L. Broad.

**Lake Carriers' Association.** President—J. S. Ashley. Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

**National Association of Engine and Boat Manufacturers,** 420 Lexington Avenue, New York City. Secretary—Ira Hand.

**National Association of Masters, Mates and Pilots.** National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

**National Marine Engineers' Beneficial Association.** Headquarters 311-315 Machinists Building, Washington, D. C. President—Wm. F. Yates. Secretary—Albert L. Jones.

**Neptune Association,** 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Milliken.

**New York and New Jersey Dry Dock Association.** 111 Broadway, New York. President—Jonathan Moore.

**Ocean Association of Marine Engineers.** 15 Whitehal St., New York. Secretary—Bert L. Todd.

**Port of New York Authority,** 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

**Society of Naval Architects and Marine Engineers,** 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

**The Maritime Association of the Port of New York,** 78 Broad St., New York City. President—John Dowd. Secretary—John F. Manning.

**The New York Tow Boat Exchange,** 11 Moore St., New York. Manager—Langdon W. Smith.

**The Propeller Club of the Port of New York.** President—Harry W. Parsons, 111 Broadway, New York. Secretary—W. Z. Gardner, 136 Liberty Street, New York.

**United States Naval Institute.** Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

**United States Ship Operators' Association,** 149 Broadway, New York. President—Winchester Noyes.

### Canada

**Grand Council N. A. of M. E. of Canada.** Grand Secretary-treasurer—W. A. MacDonald, 62 Albert St., Halifax, N. S.

### Great Britain

**Institute of Marine Engineers Incorporated,** 85-88 The Minories, London E.1.

**Institution of Engineers and Shipbuilders in Scotland,** 39 Elmbank Crescent, Glasgow.

**Institution of Naval Architects,** 5 Adelphi Terrace, London, W. C.

**North East Coast Institution of Engineers and Shipbuilders.** Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

### France

**Association Technique Maritime et Aëronautique.** Secrétariat Général—7, rue de Madrid, Paris (8e).

### Italy

**Collegio Degli Ingegneri Naval e Meccanici In Italia.**

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